

Studies of Nearctic Aquatic Insects

I. Nearctic Alder Flies of the Genus *Sialis*

(Megaloptera, Sialidae)

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BIOLOGY AND ECOLOGY

IN American literature the genus *Sialis* has been in confusion for some time because of the fact that all authors, except Banks, have recognized only three nearctic species, *americana*, *nevadensis* and *infumata*. *Americana* and *nevadensis* differ from *infumata* in color and sculpturing and have long been recognized correctly. Everything else has been grouped under *infumata*. The only effort to enlighten the problem was made by Banks, who described four species chiefly on the basis of genital characters. In spite of this prophetic indication, no other extensive work has been done.

Critical study of the genitalia has revealed no less than 10 eastern and six western species grouped under the name *infumata*. As a result the observations and records in literature of "*Sialis infumata*" can have no specific validity unless the actual specimens involved are re-identified.

The biology and habits of the genus have been treated in detail by Davis (1903), so that only a brief resumé taken chiefly from his study need be given here. The *Sialis* adults, fig. 1 (p. 58), with few exceptions are fairly large, black, broad insects, only moderately rapid in their movements. They are diurnal, most active during the middle of the day. The eggs, fig. 2, are cylindrical, rounded at the top and have an apical curled tassel. They are laid in rows forming large masses, situated on branches, bridges, and other objects hanging over water. Upon hatching, the larvae, fig. 3, presumably fall into the water,

where development takes place. The larvae are predaceous, hunting under stones, etc., for their prey. Respiration occurs through the tracheal filaments on the sides of the abdomen. When full grown the larvae crawl out of the water and dig into the bank to form an earthen cell several feet from the water's edge. Here pupation occurs, the adult emerging from this pupal cell. The life of the adult is probably short, since it has soft mouthparts which do not appear fitted for extensive feeding.

Habitat Preference

Judging from present data the species inhabit all variety of fresh-water situations in which aeration is good. The habitat range, therefore, is from small streams to large rivers and lakes, and for the same species it may be equally variable. Thus in Illinois *S. velata* has been taken only along rivers whereas *mohri* has been taken abundantly along rivers and around the northern lakes. In Michigan, however, Dr. T. H. Frison has taken both these species in large numbers on Houghton lake, associated unmistakably with the lake fauna.

SEASONAL SUCCESSION.—The adults occur with the early spring fauna in Illinois, and at a proportionately later date farther north. Data on hand certainly indicate a seasonal succession of species within the genus. Collecting dates for the three commoner eastern species indicate that *velata* appears earliest in the season, *mohri* soon after and *itasca* last. Average dates for the collection of males of these three in Illinois are, respectively, April 27,

May 21 and June 13. This tells neither the duration of the emergence period nor the overlapping between species, but it gives some approximation of the difference in time between peaks of abundance. Dr. Frison made a large collection of *velata* and *mohri* at Houghton lake, Mich., June 15 to 18, 1935, which gives a good illustration of the overlapping of these species where they occur in the same habitat. The earlier species *velata* was represented by 76 specimens, of which 67 per cent were females, all extremely gravid; *mohri* was represented by 353 specimens of which only 47 per cent were females, half of which appeared relatively fresh. From this it would seem that the population wave of one species breaks over that of the preceding species soon after the latter begins to wane.

Distribution

With the small amount of material collected at present, plotted records of individual species give only scanty maps. Even so a few interesting points are brought out. Some species, such as *velata* and *mohri*, are widespread, occurring from the Atlantic to the eastern base of the Rocky mountains. On the other hand, *iola* is restricted to the Appalachian region. Several species are distinctly western, occurring in the Rocky mountain region or westward, as for example, *californica*, *hamata* and *rotunda*.

Physiological Segregation of Species

There are several pairs of species in *Sialis* which are very closely related, such as the combinations *velata-itasca*, *aequalis-vagans*, *iola-joppa* and *californica-occidens*. Analysis of their known distribution records brings out the following points:

(1) Both members of such a pair of species have never been collected together at the same time and place. In the case of *iola* and *joppa* the geographic range and seasonal timing of both species are apparently quite similar, but in no case have specimens of both been submitted bearing exactly the same collection labels. This would indicate that each species has a different habitat preference within the same range.

(2) In the case of *velata* and *itasca* we have two forms with approximately the same range. All data indicate, however, that the two species have radically different

seasonal adjustments, *velata* appearing early and *itasca* late, their average collection dates for the same locality being four to six weeks apart.

(3) The pair *californica* and *occidens* present an interesting type of difference in range. *Californica* occurs through the Rockies from north of 50° to at least northern California, and down the coastal range to Kern county, Calif. On the other hand, *occidens* has so far been collected only

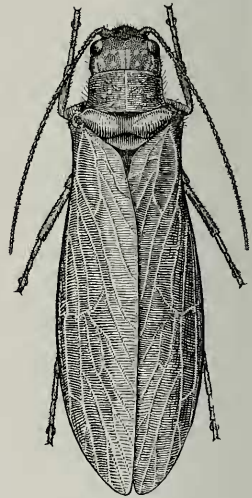


Fig. 1.—Adult of *Sialis mohri*.

around Reno, Nev., and the upper Sierra Nevada in California.

A similar marked difference in range is shown by the eastern pair, *aequalis* and *vagans*. The former is distinctly a southern and eastern species of restricted range, having been collected in Virginia, Maryland, New Jersey and southern Pennsylvania. The range of *vagans* begins where that of *aequalis* ends, and continues north to Quebec and west to Illinois and Michigan. The northern species has a much more extensive range than the southern one.

This information shows that the morphological differences which are the tangible characters separating the species recognized in this paper coincide with physiological differences expressed by ecological orientation.

Preservation and Preparation of Material

The most satisfactory method of preserving specimens seems to be in fluid. We have used 80 per cent ethyl alcohol with good results. Genitalia and other diagnostic parts of specimens so preserved usually may be seen without injuring the specimen or performing other preparation. If a specimen is pinned, its abdomen must usually be removed and cleared before it is possible to give a complete diagnosis. The follow technic has been used with fine results: soak the abdomen for three to six hours in cold 10 per cent caustic potash (KOH) solution, change to distilled water for an hour or more, then with forceps and needle gently press out the dissolved viscera. This leaves a fairly transparent shell which may be preserved and studied in 80 per cent alcohol or glycerin.

Illustrations

The illustrations of genitalia used in this paper are made from specimens treated in caustic potash solution. They are drawn with the parts considerably expanded, since it is only in such a position that some details can be seen clearly.

Value of Characters

Genitalia have provided the best characters for separation of species, although other characters may be of value. Differences in wing venation are subject to considerable individual variation and may be expressed at best as averages and not as absolute characters. For example, *californica* usually has three or four branches of R_2 , but may have only two, whereas *velata* and some others usually have only two branches of R_2 but may have three or four. The cross-veins of the costal area of the front wing vary in the same fashion: *americana* has four to six, *mohri* has four to 10, averaging seven, and the others have 10 to 15, averaging 12 or more. Differences in punctuation and gloss of the head are quite constant, but offer no differences between many species. It is difficult to express some of these characters, since the differences are relative and can be recognized only after acquaintance with the various types.

Terminology of Genitalia

Use of genitalia necessitates a terminology for its components, and since no one has homologized them definitely with those of other insects an original set of

terms is proposed for them. No attempt is made here to homologize these parts; instead the names are purely descriptive and are used as a convenience. The names applied to the genital parts are as follows:

(1) **Lateral plates:** a pair of plates on the venter beyond the eighth sternite, fig. 4, l, p. 000.

(2) **Terminal plate:** a single plate on the caudal end of the abdomen, which assumes many shapes, fig. 4, t.

(3) **Genital plate:** a pair of sclerites forming a more or less solid plate on the venter between the above two parts, fig. 4, g. From this arise various appendages called **genital hooks**, figs. 12, 28.

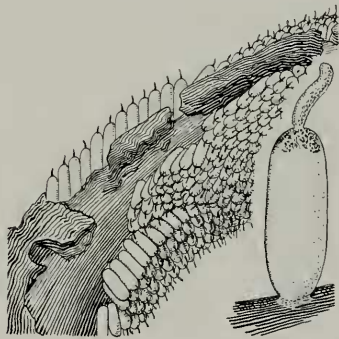


Fig. 2.—Eggs of *Sialis mohri*.

TAXONOMY

From the standpoint of phylogenetic position *Sialis* is an interesting genus. Many generalized features of its structure and biology place it as one of the most archaic genera of holometabolous insects. The group comprising *Sialis*, *Corydalid*, *Chauliodes* and allied genera has been considered by some authors as a member of the order Neuroptera and by others as a separate order Megaloptera. Due to its apparent axial position with reference to the phylogeny of the Neuroptera, Mecoptera and Hymenoptera, it seems clearer to designate the group as a distinct order.

Most recent authors consider that the family of Sialidæ is composed of two well-marked subfamilies: the Sialinæ, including *Sialis*, and the Corydalinae, including *Corydalid*, *Chauliodes* and their allies. The separating characters between the two groups seem of sufficient magnitude to warrant recognition of each as a distinct

family. Recognition was accorded by Brues & Melander (1932, p. 179), using the name first proposed by Burmeister (1839, p. 948).

Table 1.—Distinguishing features of *Sialidae* and *Corydalidae*.

| SIALIDAE | CORYDALIDAE |
|---|---|
| <i>Adult</i> | |
| No ocelli | Three distinct ocelli |
| Fourth tarsal segment dilated and deeply bilobed | Fourth tarsal segment cylindrical |
| <i>Larva</i> | |
| Abdomen with a long terminal filament on the meson, fig. 3. | Abdomen with a pair of apical prolegs each bearing a strong hook. |

Table 1 gives distinguishing features of the two families, *Sialidae* and *Corydalidae*¹. Townsend (1935) has separated the larvæ of these groups from others with which they might be confused.

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Present Holders of Material: Symbols

| | |
|-------|---|
| AM. | American Museum of Natural History |
| ANS. | Academy of Natural Sciences of Philadelphia |
| BM. | British Museum |
| CAS. | California Academy of Sciences |
| CM. | Carnegie Museum |
| CNM. | Canadian National Museum |
| CU. | Cornell University |
| FM. | Field Museum |
| INHS. | ILLINOIS NATURAL HISTORY SURVEY |
| KAC. | Kansas Agricultural College |
| MCZ. | Museum of Comparative Zoology |
| MMZ. | University of Michigan Museum of Zoology |
| NM. | U. S. National Museum |
| OAC. | Oregon Agricultural College |
| OSU. | Ohio State University |
| UAC. | Utah Agricultural College |
| UI. | University of Idaho |
| UK. | University of Kansas |
| UM. | University of Minnesota |
| UW. | University of Wisconsin |

DESCRIPTION OF SPECIES

SIALIDAE

This family contains only one nearctic genus, *Sialis*, which is characterized in table 1.

Sialis Latreille

Sialis Latreille (1802, p. 290; 1803, p. 287; 1810, p. 435); Burmeister (1839, p. 945); Hagen (1861, p. 187); Davis (1903, p. 443). Genotype *Semblis lutaria* Fabricius by subsequent designation of Latreille (1810, p. 435).

Semblis Rambur *nee* Fabricius (1842, p. 446). *Protosialis* Wheeler (1909, p. 263; 1910, p. 74). Monobasic, genotype *Semblis americana* Rambur. *New synonymy*.

Generic Characteristics

ADULT, FIG. 1.—Head broad and long, prognathous, with eyes situated on anterior half; clypeus narrow; labrum wide, entire

in the female and cleft almost to its base in the male; antennae long, slender and multi-segmented. Posterior part of head with raised bars and dots forming a constant pattern, these raised areas always at least shining if not glossy. Pronotum large and rectangular, about 2½ times as wide as long, dull to slightly shining. Mesonotum no longer than pronotum, extremely convex transversely. Metanotum similar in size and shape to mesonotum. Wings with venation as illustrated by several authors. Abdomen cylindrical, the apex with genital apparatus as illustrated for each species.

LARVA, FIG. 3.—Head and thorax considerably flattened, smooth and shining. Head quadrate, eye-spot composed of about six facets, antennae four segmented, clypeus

¹The type of genitalia also, is different in each group.

wide and narrow, labrum produced into a long, pointed flap covering the elongate mouthparts. Pronotum quadrate, as long as head. Mesonotum and metanotum subequal, together as long as the pronotum. Thoracic legs well developed and long, with coxae almost as long as the femora.

Abdomen fairly robust, the first seven segments with a pair of lateral processes.

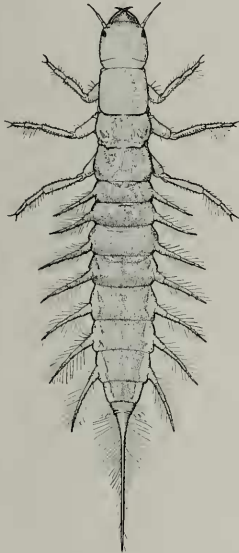


Fig. 3.—Larva of *Sialis* sp.

Each of these is slender and tapers to a fine point, and is composed of five distinct segments, the apical one sometimes with a trace of a division. The apex of the abdomen is produced into a median process which is broad at the base and tapers to a long fine point. The entire process is almost as long as the abdomen.

The genus *Protosialis* is considered a synonym of *Sialis*. It was erected for *S. americana* on the basis of this species having a reduced number of cross-veins in the costal area of the front wing. A complete intergradation between both extremes of this character may be found in *S. mohri*, so that wing venation alone will not serve as a basis for generic separation of *Protosialis* from *Sialis*. The entire lot of species, however, may be grouped into several units on

the basis of the male genitalia, supplemented by other characters, as shown in table 2.

The segregations shown undoubtedly represent distinct phylogenetic units within the genus, but their designation as separate genera seems an unnecessary complication. Hence the dropping of *Protosialis*.

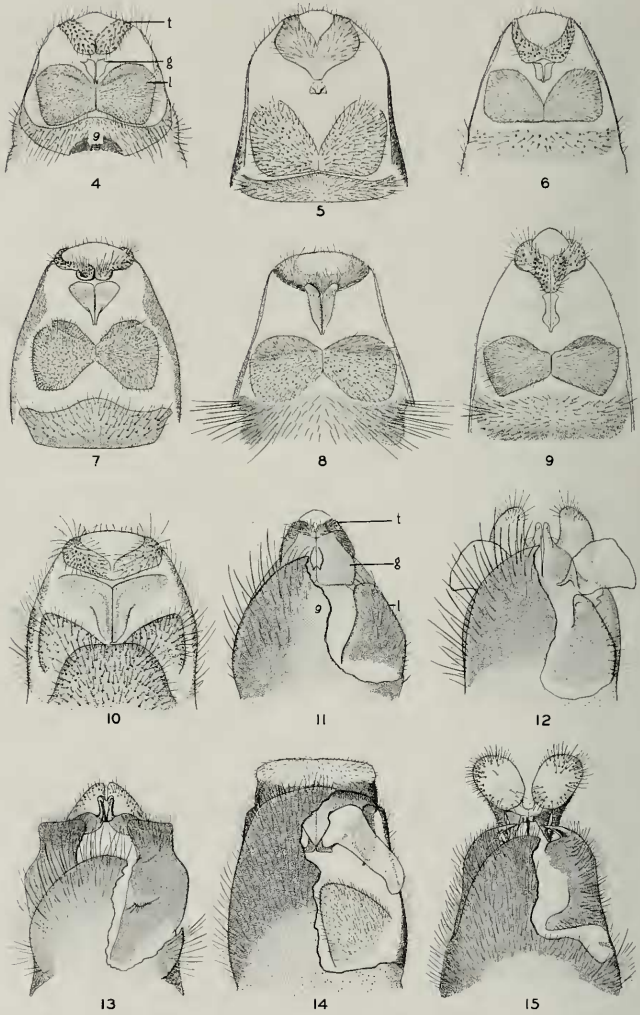
Table 2.—Phylogenetic units of North American species of *Sialis*.

Genitalia Relatively Simple, Fig. 4; No Parts Greatly Enlarged

| | |
|---|--------------------|
| | CALIFORNICA GROUP |
| | <i>arvalis</i> |
| | <i>californica</i> |
| Genital arms very short, | <i>iola</i> |
| hooked, fig. 18..... | <i>cornuta</i> |
| | <i>hamata</i> |
| | <i>joppa</i> |
| | <i>occidens</i> |
| | AMERICANA GROUP |
| Genital arms long, straight, | <i>americana</i> |
| fig. 22..... | <i>glabella</i> |
| <i>Genital Plate with Long Hooks, Figs. 28-33</i> | |
| | INFUMATA GROUP |
| Terminal plate produced | <i>velata</i> |
| only along vertical axis, | <i>itasca</i> |
| figs. 28-31..... | <i>concava</i> |
| | <i>infumata</i> |
| | <i>hasta</i> |
| Terminal plate with a long | |
| forked process at right | |
| angles to its axis, fig. 32. | <i>mohri</i> |
| <i>Ninth Sternite Produced into a Flap</i> | |
| <i>Covering Genitalia, Fig. 23</i> | |
| Head of male with a horn- | |
| like process, fig. 43..... | <i>rotunda</i> |
| Terminal plate with a pair | |
| of large knobs, fig. 27.... | <i>nevadensis</i> |
| | AEQUALIS GROUP |
| Terminal plate without | <i>aequalis</i> |
| knobs, fig. 25..... | <i>vagans</i> |

The genotype of *Sialis*, which is *lutaria* (Fabricius) belongs to the *aequalis* group. It is typical in color, size and general structure for these species but differs in male genitalia as follows, figs. 14, 26; ninth sternite produced into a flap which is semi-truncate at apex; lateral plates small, pointed at tip; genital plate with long hooks and a membranous pair of flaps at base, fig. 26a; terminal plate large and truncate at apex, fig. 26b.

Application of the name *Semblis* to this group was proposed by Rambur (1842), but application of the name to a genus of Phryganeidae by Milne (1934), with *Semblis phalaenoides* (L.) as its genotype, seems a better disposition and is so accepted.



VENTRAL ASPECT OF GENITALIA AND NINTH SEGMENT OF SIALIS MALES

Fig. 4.—*S. joppa*.

Fig. 5.—*S. hamata*.

Fig. 6.—*S. arvalis*.

Fig. 7.—*S. cornuta*.

Fig. 8.—*S. californica*.

Fig. 9.—*S. iola*.

Fig. 10.—*S. americana*.

Fig. 11.—*S. vagans*.

Fig. 12.—*S. aequalis*.

Fig. 13.—*S. rotunda*.

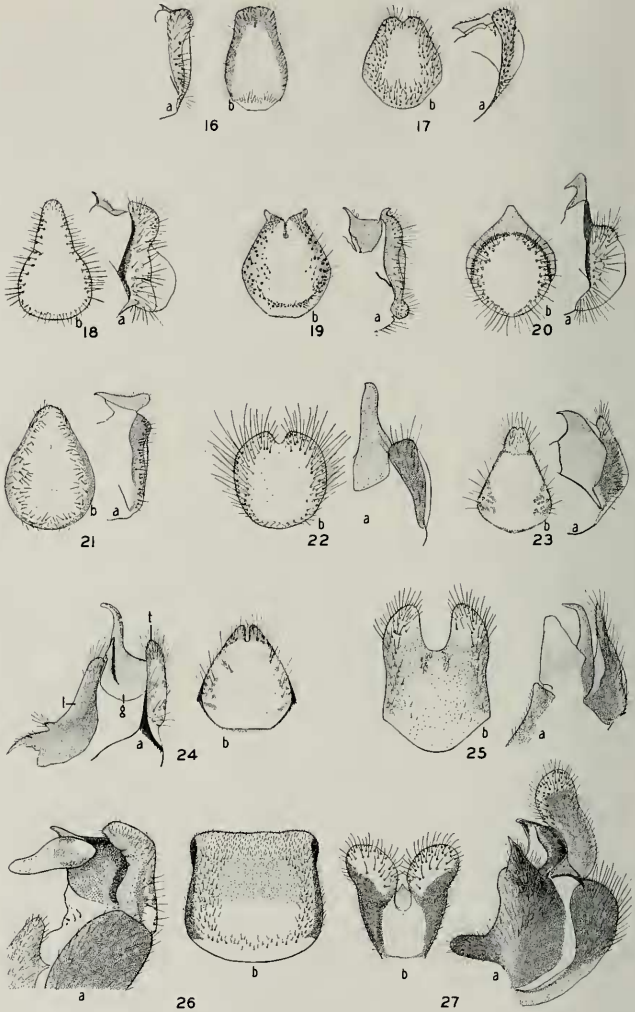
Fig. 14.—*S. lutaria*.

Fig. 15.—*S. nevadensis*.

ABBREVIATIONS.—1, lateral plate; t, terminal plate; g, genital plate; 9, ninth sternite.

KEY TO NEARCTIC SPECIES OF SIALIS

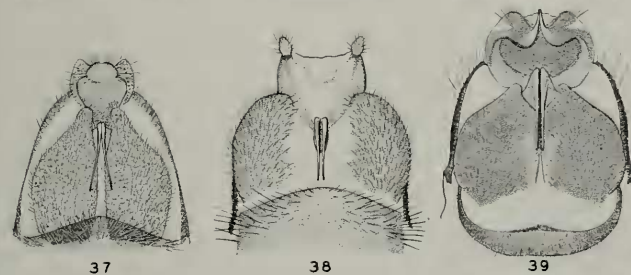
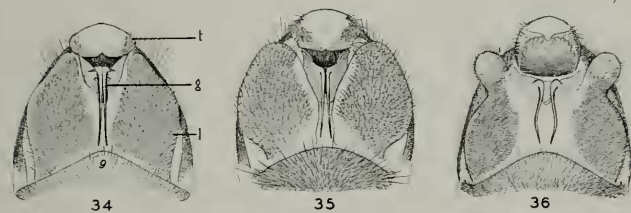
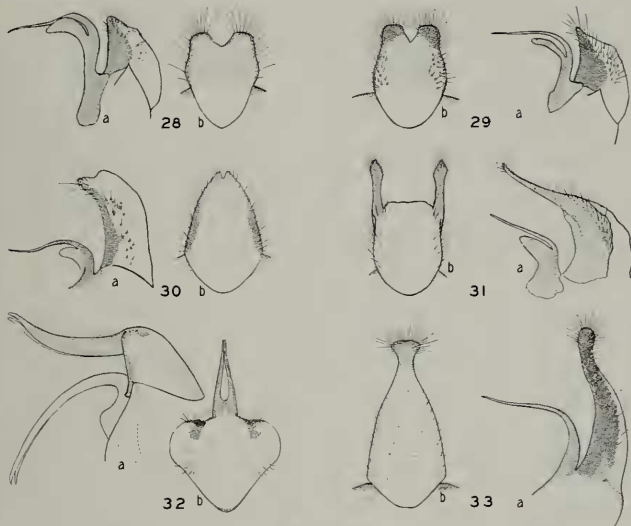
1. Apex of abdomen with broad, rounded ovipositor, fig. 51 (females).....20
Apex of abdomen without an ovipositor but with a more or less complicated assemblage of parts, figs. 4-15 (males)..... 2
2. Front between eyes with a prominent hornlike process, fig. 43.....**rotunda**
Front between eyes without a hornlike process..... 3
3. Ninth sternite produced into a flap covering most of the genitalia, figs. 11-15..... 4
Ninth sternite not produced into a flap, figs. 4, 34..... 6
4. Apex of lateral plates with a strong tooth, fig. 15..... **nevadensis**
Apex of lateral plates without a tooth... 5
5. Terminal plate wide with apex divided into two large processes, fig. 25b....
..... **aequalis**
Terminal plate narrowed at apex and not markedly incised, fig. 23b. **vagans**
6. Terminal plate produced at apex into a pair of long arms, figs. 31b, 32b... 7
Terminal plate sometimes with an apical incision, fig. 28b, or a pair of short "horns," fig. 19b, but not with a pair of long arms..... 8
7. Apical arms of terminal plate separated at their base by a distance almost equal to their length, fig. 31b..... **hasta**
Apical arms of terminal plate close together at base and converging at tip, fig. 32b..... **mohri**
8. Legs with femora rufous and tibiae the same color or blackish..... 9
Legs black, or with tibiae slightly lighter than femora.....10
9. Head smooth and polished..... **glabella**
Head punctured and dull..... **americana**
10. Genital hooks long and whiplike, figs. 28-33, extending forward between the lateral plates, figs. 34-39.....11
Genital hooks short, never longer than the plate from which they arise, figs. 16-21; lateral plates always closely appressed on meson, figs. 4-9.....14
11. Apex of lateral plates produced into large knobs, fig. 36..... **infumata**
Apex of lateral plates not knoblike...12
12. Terminal plate long, its apex slightly enlarged but not cleft, fig. 33b; genital hooks simple, without a basal lobe, fig. 33a..... **concava**
Terminal plate short, its apex markedly cleft, fig. 29b; genital hooks with a basal lobe, fig. 29a..... 13
13. Basal lobe of genital hooks smaller, as in fig. 29a; terminal plate as long as genital hooks are high, fig. 29b. **velata**
Basal lobe of genital hooks markedly robust compared with distal lobe, fig. 28a; terminal plate shorter than genital hooks are high, fig. 28b. **itasca**
14. Apex of terminal plate produced into two short, stout, curved "horns," fig. 19..... **cornuta**
Apex of terminal plate not with hornlike processes..... 15
15. Apex of terminal plate produced into a thin, flat "neck," at the end of which the genital hook articulates, fig. 20; this hook, fig. 20a, strongly recurved to form the swan's neck type of hook..... **hamata**
Apex of terminal plate without a necklike process, fig. 21; genital hooks not recurved..... 16
16. Basal portion of genital plates, figs. 21, 49, projecting above apex of terminal plate; ninth sternite with lateral setae long and whiskerlike, fig. 8..... 17
Basal portion of genital plates neither enlarged nor projecting over terminal plate, figs. 16 to 18a, ninth sternite with fairly short lateral setae, figs. 4, 9..... 18
17. Genital plate as in figs. 8 and 21a, the base narrow and produced into two bulbous elevations..... **californica**
Genital plate as in fig. 49, the base wider, and not produced into two bulbous knobs..... **occidens**
18. Terminal plate with the apex narrow, tapered to a blunt point and not incised on meson, fig. 18b..... **iola**
Terminal plate with apex wider, and either markedly incised or almost truncate, figs. 16, 17b..... 19
19. Terminal plate almost as wide as long, more or less pentagonal, fig. 17b; genital plates more than a third as long as terminal plate, fig. 17a... **joppa**
Terminal plate $1\frac{1}{2}$ times as long as wide, more or less quadrangular, fig. 16b; genital plates less than a fourth as long as terminal plate, fig. 16a...
..... **arvalis**
20. Ninth sternite large, triangular and distinctly sclerotized, fig. 56... **mohri**
Ninth sternite apparently membranous and difficult to distinguish in un-cleared specimens..... 21
21. Eighth sternite large and with a long narrow cleft on the apical margin, fig. 63..... **nevadensis**
Eighth sternite never with such a cleft. 22
22. Legs with femora rufous and tibiae the same color or darker than femora... 23
Legs either entirely black or with the tibiae lighter than the femora..... 24
23. Head smooth and polished..... **glabella**
Head punctured and dull..... **americana**
24. Both clypeus and front just above it with a small but fairly conspicuous tuft of black hairs on the meson. Median depression of eighth sternite very large and deep, fig. 55... **rotunda**
Clypeus and front without any trace



GENITALIA OF SIALIS MALES

Fig. 16.—*S. arvalis*.Fig. 17.—*S. joppa*.Fig. 18.—*S. iola*.Fig. 19.—*S. cornuta*.Fig. 20.—*S. hamata*.Fig. 21.—*S. californica*.Fig. 22.—*S. americana*.Fig. 23.—*S. vagans*.Fig. 24.—*S. rotunda*.Fig. 25.—*S. aequalis*.Fig. 26.—*S. lutaria*.Fig. 27.—*S. nevadensis*.

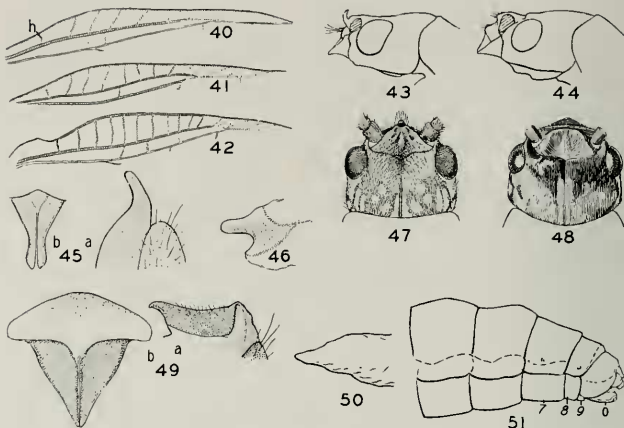
ABBREVIATIONS.—a, lateral view of genital and terminal plates; b, caudal view of terminal plates; g, genital plate; l, lateral plate; t, terminal plate.



GENITALIA OF SIALIS MALES

- Fig. 28.—*S. itasca*.
- Fig. 32.—*S. mohri*.
- Fig. 36.—*S. infumata*.
- Fig. 29.—*S. velata*.
- Fig. 33.—*S. concava*.
- Fig. 37.—*S. concava*.
- Fig. 30.—*S. infumata*.
- Fig. 34.—*S. itasca*.
- Fig. 38.—*S. hasta*.
- Fig. 31.—*S. hasta*.
- Fig. 35.—*S. velata*.
- Fig. 39.—*S. mohri*.

ABBREVIATIONS.—a, lateral view of genital and terminal plates; b, caudal view of terminal plate; g, genital plate; l, lateral plate; t, terminal plate; 9, ninth sternite.

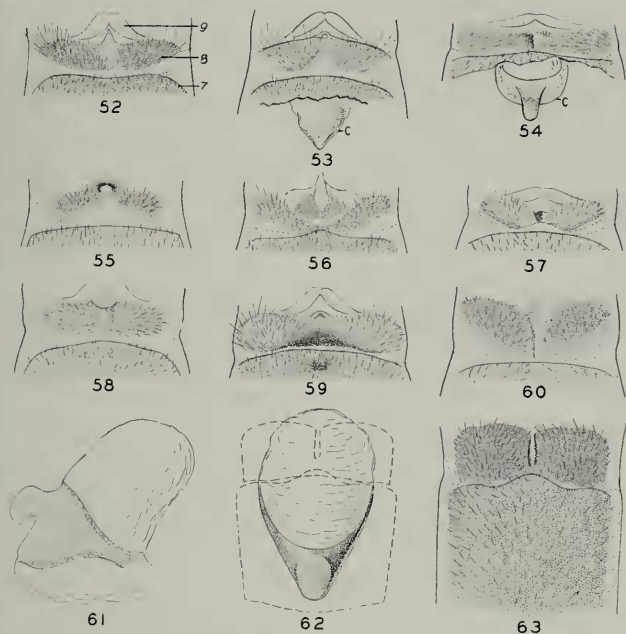


STRUCTURES OF SIALIS MALES AND FEMALES

- Fig. 40.**—Costal area of front wing of *S. glabella*.
Fig. 41.—Costal area of front wing of *S. mohri*.
Fig. 42.—Costal area of front wing of *S. infumata*.
Fig. 43.—Lateral view of head of male *S. rotunda*.
Fig. 44.—Lateral view of head of female *S. rotunda*.
Fig. 45.—Genitalia of male *S. glabella*.
Fig. 46.—Lateral view of bursa copulatrix of *S. infumata*.
Fig. 47.—Dorsal view of head of male *S. rotunda*.
Fig. 48.—Dorsal view of head of *S. nevadensis*.
Fig. 49.—Genitalia of male *S. occidens*.
Fig. 50.—Lateral view of bursa copulatrix of *S. joppa*.
Fig. 51.—Lateral view of abdomen of female *S. infumata*.
- ABBREVIATIONS.—a, lateral view of genital and terminal plates; b, ventral view of genital plate and hooks; h, humeral cross-veins; o, ovipositor; 7, 8, 9, abdominal sternites.

KEY TO NEARCTIC SPECIES OF SIALIS—Concluded

- | | |
|---|--|
| <p>of a tuft of hairs. Median depression of eighth sternite not as large. 25</p> <p>25. Eighth sternite narrow and divided into two separate lobes by a median depression, fig. 57. <i>aequalis, vagans</i></p> <p>Eighth sternite either wider, fig. 60, or not divided so completely into two separate parts, fig. 54. 26</p> <p>26. Eighth sternite as in fig. 60, rectangular and with the distal portions set out as distinct swellings. <i>infumata</i></p> <p>Eighth sternite not as in fig. 60, either with apex rounded out, fig. 53, or not set off with such conspicuous lobes. 27</p> <p>27. Eighth sternite flat, not tilted so that the apical margin is raised, fig. 54. Bursa copulatrix with a terminal fingerlike process. <i>velata, itasca</i></p> <p>Eighth sternite tilted so that the apical margin is markedly raised and basal</p> | <p>margin depressed, figs. 53, 59. Bursa copulatrix with terminus triangular, fig. 53. 28</p> <p>28. Species occurring only east of the Great Plains region. <i>iola, joppa</i></p> <p>Species occurring only west of the Great Plains region. 29</p> <p>29. Median depression situated near the tip of a long, slender mesal process on the apical margin of the eighth sternite, fig. 52. <i>hamata</i></p> <p>Median depression not situated on such a long slender process. 30</p> <p>30. Apex of eighth sternite not evenly rounded, fig. 59. Lateral area of eighth sternite with abundant and dark setae. <i>californica, occidens</i></p> <p>Apex of eighth sternite evenly rounded, much as in fig. 53. Lateral area of eighth sternite with considerably less abundant and light-colored setae. <i>cornuta</i></p> |
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APICAL STERNITES OF SIALIS FEMALES

Fig. 52.—*S. hamata*.

Fig. 53.—*S. joppa*, showing bursa copulatrix *in situ*.

Fig. 54.—*S. velata* showing bursa copulatrix *in situ*.

Fig. 55.—*S. rotunda*.

Fig. 56.—*S. mohri*.

Fig. 57.—*S. aequalis*.

Fig. 58.—*S. americana*.

Fig. 59.—*S. californica*.

Fig. 60.—*S. infumata*.

Fig. 61.—Lateral view of bursa copulatrix of *S. nevadensis*.

Fig. 62.—Bursa copulatrix of *S. nevadensis* as seen through venter of abdomen.

Fig. 63.—*S. nevadensis*.

ABBREVIATIONS.—c, bursa copulatrix; 7, 8, 9, abdominal sternites.

Sialis joppa—NEW SPECIES

MALE.—Length 12 mm. Head, body and appendages black with the following exceptions: raised lines and dots on head and narrow ring around eye, yellowish; legs shading to brown; wings dark brown, slightly lighter towards apex.

GENERAL STRUCTURE.—Front and adjoining portion of vertex slightly roughened but highly polished, concave. Remainder of head dull and shagreened except raised areas on front and vertex. Front wing with eight to 12 supernumerary cross-veins in costal area; radius 3 with two or three branches.

Abdomen and genitalia as in figs. 4 and 17. Ninth sternite narrow and bandlike, clothed with abundant short setae, and sometimes with depressed area on the meson of the basal margin. Lateral plates more or less ovoid, typically closely appressed on meson. Genital plate small, as wide as its mesal length, with a pair of short, closely appressed genital hooks, fig. 17b. Terminal plate ovoid, fig. 17a, tending to be pentagonal, ventral margin or apex forming two low rounded lobes separated by a slight incision on the meson.

FEMALE.—Length 14 mm. Color and general structure as in male, except for the

head, which may be swollen behind the eyes.

Abdomen and genitalia as in fig. 53. Seventh sternite heavily sclerotized, appearing longer than wide due to convexity; sometimes with a small swelling on meson near apex. Eighth sternite tilted, the base depressed and apex raised; the mesal portion slightly depressed longitudinally; the setae only moderately long. The apical margin of the segment bears a small round depression on the meson; if the segment is stretched out there can be seen a small pointed process running forward from under this depression. Ninth sternite membranous but fairly rigid, forming a wide V. Tip of bursa copulatrix entirely membranous, fig. 50, triangular in dorsal view, fig. 53.

Holotype, male.—Newfound Gap, Great Smoky Mountain National Park, N.C.: May 28, 1934, T. H. Frison, INHS.

Allotype, female.—Same data as for holotype.

Paratypes.—Same data as for holotype and allotype, 1♂, 1♀.

ILLINOIS.—Eichorn, Buck creek: Apr. 22, 1932, Ross & Mohr, 1♂, INHS.

MAINE.—Naples: Farley, 1♂, INHS.

NEW HAMPSHIRE.—White mountains, Alpine: 1♂, INHS. Gorham: 1♂, MCZ.

NEW YORK.—Crosby: May 20, 1920, 1♂, cu. Ithaca: May 23, 1915, 1♂, cu. McLean: June 2, 1923, 1♂, INHS. Stanley: May 17–20, C. R. Crosby, 1♂, INHS; 1♀, cu. Williams: May 31, 1913, 2♂, 2♀, cu; 1♂, 1♀, INHS.

NORTH CAROLINA.—North fork Swannanoa river, May, 1♂, MCZ.

OHIO.—Sugar Grove: April 17, 1902, 1♂, OSU.

PENNSYLVANIA.—Castle Rock: May 21, 1908, 1♂, ANS. Jeanette: H. G. Klages, 1♂, cm. Two miles north of Narberth, Montgomery county: May 16, 1925, E. T. Cresson, Jr., 1♂, ANS. Philadelphia: May 11, 1♂, INHS.

This is a decidedly eastern species, its distribution resembling that of *iola*. The Ohio and Illinois records, however, are more western than any records of *iola*.

Total size and color of wings vary considerably in both sexes. This species is closest to *arvalis* and *iola* but may be separated from them in the male by the shape of the terminal plate. The females of this entire group are difficult to separate.

Sialis arvalis—NEW SPECIES

MALE.—Length 11 mm. Color and general structure similar to *joppa*. Differs only in details of abdomen and genitalia figs. 6, 16. Ninth sternite handlike, clothed with scattered short setae. Lateral plates somewhat ovoid, mesal side angular and

appressed on meson for a short distance. Genital plate very small, quadrate and with a pair of short genital hooks, fig. 16a. Terminal plate, fig. 16b, rectangular in general outline, the apex divided into two lobes which are considerably swollen.

FEMALE.—Unknown.

Holotype, male.—Mokel Hill, Calif., April, F. E. Blaisdell, CAS.

Paratypes. CALIFORNIA.—Mokel Hill: F. E. Blaisdell, 1♂, CAS; 1♂, INHS. Yorkville, Mendocino County: April 30, 1934, E. P. Van Duzee, 1♂, CAS.

Sialis iola—NEW SPECIES

MALE.—Length, color and general structure similar to *joppa*. Differs only in details of genitalia, figs. 9, 18. Ninth sternite handlike and with only moderately long setae. Lateral plates more or less ovoid and appressed on meson. Genital plate small, narrower than its mesal length, with a pair of short, closely appressed genital hooks, fig. 9. Terminal plate triangular in general outline, the apex round and very narrow, without an incision on the meson.

FEMALE.—Apparently identical with that of *joppa*.

Holotype, male.—Pittsburgh, Pa. INHS.

Allotype, female.—Same data as for holotype.

WASHINGTON, D. C.—April 1928, 3♂, 1♀, NM; 2♂, 1♀, INHS.

NEW JERSEY.—Riverton: May 4, 1903, 2♂, INHS. Paterson: June 10, 1♂, AM.

NEW HAMPSHIRE.—Durham: 1♂, cu.

NEW YORK.—Axton, Adirondack mountains: June 12–22, 1901, 5♂, 1♀, cu; 2♂, 1♀, INHS. Black brook, Clinton county: June 11, 1916, 1♂, 1♀, cu. McLean: May 31, 1913, 1♂, 1♀, INHS; 1♂, 1♀, cu. McLean bogs, Tompkins county: May 29, 1915, 1♂, cu. Ringwood, Ithaca: June 26, 1920, 1♂, 1♀, cu.

PENNSYLVANIA.—Inglenook: May 31, 1914, 1♂, MCZ. Pittsburgh: May 22, 1899, 1♂, cm.

QUEBEC.—Fairy lake: June 1, 1927, 1♀, CNM. Knowlton: June 5–14 and July 12, 5♂, 5♀, CNM; 5♂, 5♀, INHS. Lachine: June 4, 1930, L. J. Milne, 1♂, CNM.

Sialis californica Banks

Sialis fuliginosa Davis (1903, p. 449) in part [nec Pictet].

Sialis infumata Davis (1903, p. 448) in part [nec Newman].

Sialis californica Banks (1920, p. 326).

MALE.—Length 11–14 mm. Color and general structure as in *joppa* except that many specimens are larger and have the wings solid iridescent black. This darker coloration intergrades to a light brown in a long series.

Abdomen and genitalia, figs. 8, 21. Ninth sternite bandlike, the mesal portion clothed with only moderately long setae, but the lateral portions bearing many long setae which project considerably beyond the lateral margins of the segment to give the appearance of a bushy set of cat's whiskers, fig. 8. Lateral plates ovoid, appressed for a distance on the meson. Genital plate narrow, evenly tapered to apex where it is produced into a pair of short hooks; the base of the plate, fig. 21a, bulbous and raised above the apex of the terminal plate. Terminal plate, fig. 21b, triangular in outline, the extreme apex rounded but not divided into two lobes.

FEMALE.—Length 12-16 mm. Color and general structure as in male.

Abdomen and genitalia as in *joppa* with the following differences: eighth sternite, fig. 59, with the apical margin raised, incised on meson, the mesal depression fairly large and bounded apically by a narrow bridge; basally from this extends a fan-shaped, concave area with few or no setae; on either side of this the segment is raised and these raised areas are clothed with setae which are longer than those on other females in the *californica* group. Bursa copulatrix with the tip more or less sclerotized, triangular from the ventral aspect, somewhat beaked from the lateral aspect.

Lectotype, male, by present designation.—San Emigdio cañon, Kern county, Calif.: F. Grinnell Jr., June 3, 1904, Type #10844, MCZ.

ALBERTA.—Jasper to Buffalo Prairie: June 30, 1915, 1♂, INHS.

BRITISH COLUMBIA.—Alta lake, Mons: June 11, 1926, J. McDunnough, 1♂, 1♀, CNM.

CALIFORNIA.—Alameda county: 1♂, INHS. Berkeley: April 14, 1928, 1♂, CAS; April 27, 1921, 1♂, INHS. Big Basin Park, Santa Cruz county: May 12, 1918, 1♂, CAS. Carrville, Trinity county, altitude 2400-2500 feet: May 19, 1935, 1♂, 2♀, CAS; 1♂, 1♀, INHS. Eureka: June 6, 1♂, NM. Phoenix lake, Marin county: April 4, 1927, 1♂, 1♀, CAS. San Emigdio canon, Kern county: 1♂, MCZ, paratype; 1♂, INHS, paratype. San Jeronimo: 1♂, MCZ, paratype; 1♂ INHS, paratype. Yorkville, Mendocino county: May 1, 1924, CAS.

OREGON.—Albany: April 25, 1934, J. Schuh, 1♀, INHS. Alsea: May 23, 1931, H. A. Scullen, 1♀, OAC; 1♀, INHS. Cannon Beach: June 10-18, 1927, 1♂, 3♀, CAS; 1♂, INHS. Corvallis: June 9, 1930, Loring G. Hudson, 1♂, INHS; April 29, 1930, H. A. Scullen, 1♂, OAC; May 15, 1925, 1♂, OAC. Oak creek: May 4, 1934, Eldon Ball, 2♀; May 22, 1934, Dimick, 1♂, INHS; May 26, 1898, 1♀, OAC. Philomath,

Rock creek: May 1, 1934, R. E. Dimick, 1♀, OAC. Santiam road, Cash creek: July 20, 1910, 1♀, OAC. Siletz river: May 24, 1934, R. E. Dimick, 1♀, OAC. Tidewater: July 3, 1933, 1♀, OAC. Warner mountains, Lake county: June 19, 1922, 1♂, 1♀, CAS.

WASHINGTON.—Stabler: June 20, 1928, K. Gray, 1♂, OAC; elevation 1500-2000 feet, 3♀, OAC; 2♀, INHS.

Sialis occidens—NEW SPECIES

Sialis fuliginosa Davis (1903, p. 449) in part [nec Pictet].

MALE.—Length 11-13 mm. Similar in all respects to *californica*, except for the genital plate. Ninth sternite, lateral plates and terminal plate as described and illustrated for *californica*. Genital plate, fig. 49, wide at base and tapering to apex, basal portion curved upward above apex of terminal plate but not forming two bulbous lobes.

FEMALE.—Apparently identical with that of *californica*.

Holotype male—Wolverton, Sequoia National Park, Calif., altitude 7000-9000 feet: June 25, 1929, E. C. Van Dyke, CAS.

Allotype, female—Same data as for holotype.

Paratypes. CALIFORNIA.—1♂, NM, Wolverton, Sequoia National Park, altitude 7000-9000 feet: June 23-25, 1♂, 1♀, CAS; 2♂, 1♀, INHS. Fallen Leaf lake, Lake Tahoe: July 2, 1♂, CAS; June 26, 1♀, CAS. Placer county: June, 1♂, INHS. Sierra Nevada: Crotch, 1♂, 1♀, MCZ.

NEVADA.—Reno: 1878, Morrison, 1♂, 2♀, MCZ; 1♂, 2♀, INHS; 1♂, 2♀, NM; 1♂, 1♀, KAC; June 27, 1927, E. P. Van Duzee, 1♀, CAS.

This species is apparently restricted to a more southern distribution than *californica*. The specimens from Reno, Nevada, collected by Morrison were recorded as *fuliginosa* by Davis.

Sialis cornuta—NEW SPECIES

MALE.—Length 12 mm. Color and general structure similar to *joppa*. Differs in details of abdomen and genitalia, figs. 7 and 19. Ninth sternite bandlike, clothed with only moderately long setae. Lateral plates more or less ovoid, mesal margins somewhat angled and appressed for a distance. Genital plate wide and deep, narrowing towards apex and produced into a pair of narrow hooks half as long as the plate; these hooks, fig. 19a, projecting almost straight upward from the plate and scarcely curved. Terminal plate ovoid and flat, fig. 19b, its apex divided into two lobes by a narrow mesal incision, each lobe produced into a short, stout, hornlike process curved laterad.

FEMALE.—Similar in all respects to that of *joppa*, with the exception of the apical mesal projection of the eighth sternite, which is slightly longer.

Holotype, male.—Horseshoe lake, Blue mountains, Ore., elevation 7500 feet: July 26, 1929, H. A. Scullen, INHS.

Allotype, female.—Same data as holotype.

Paratypes. ALBERTA.—Nordegg: July 7–11, 1921, J. McDunnough, 2♂, 2♀, CNM; 1♂, 2♀, INHS. Waterton: July 12, 1923, H. L. Seamans, 1♂, CNM; July 14, 1923, E. H. Strickland, 1♂, CNM; 1♂, INHS.

IDAHO.—Moore's lake: July 10, 1907, J. M. Aldrich, 1♂, INHS. Moscow: J. M. Aldrich, 1♀, INHS.

UTAH.—Fruitland: March 20, 1937, F. C. Harmston, 1♂, INHS. Red creek: March 20, 1937, F. C. Harmston, 1♂, UAC.

The male of this species is readily distinguished by the hornlike processes on the terminal plate, but the female is difficult to separate from others of the *californica* group (see key).

Sialis hamata—NEW SPECIES

MALE.—Length 12 mm. Color and general structure as in *joppa*. Differs in details of abdomen and genitalia, figs. 5 and 20. Ninth sternite bandlike, clothed with sparse, moderately short setae. Lateral plates more or less ovoid, appressed for a distance on the meson. Genital plates small from ventral aspect, but with a large recurved hook at apex which is apparent only in lateral view, fig. 20a. Terminal plate flat and round, the basal part produced at the apex into a thin flat neck, fig. 20b, at the end of which the genital plate articulates. This neck varies in length but is always as long as shown in the illustration.

FEMALE.—Apparently identical with that of *joppa* except for the eighth abdominal sternite, fig. 52. This is emarginate along the apex except at the meson where a narrow projection juts forward. This projection is on the same plane as the remainder of the segment. The bursa copulatrix is membranous and amorphous.

Holotype, male.—Logan, Utah: April 16, 1933, J. A. Meacham, INHS.

Allotype, female.—Blacksmith Fork cañon, Utah: July 9, 1935, C. F. Smith & G. F. Knowlton, INHS.

Paratypes. ALBERTA.—Lethbridge: Aug. 4, 1922, E. H. Strickland, 1♂, CNM. Waterton lakes: June 26–July 13, 1♂, 1♀, INHS; 3♀, CNM. Watertown: June 30, 1924, H. L. Seamans, 1♂, CNM; 1♂, INHS; July 1, 1924, H. L. Seamans, 1♀, CNM.

BRITISH COLUMBIA.—Creston: May 28, 1926, A. A. Dennys, 1♂, CNM.

MONTANA.—Lake Saint Mary, Glacier National Park: July 21, 1930, E. C. Van Dyke, 1♂, CAS; 1♀, INHS. Spring Creek, Yellowstone National Park: July 15, 1923, A. L. Melander, 1♂, MCZ.

OREGON.—Warner lake, Lake county, high tablelands: June 21, 1922, E. C. Van Dyke, 1♂, 1♀, CAS; 1♂, INHS.

UTAH.—Parley cañon, Salt Lake City: June 24, 1922, E. P. Van Duzee, 1♂, CAS.

WASHINGTON.—Pullman: May 10, 1928, 1♂, UM.

WYOMING.—West Yellowstone: June 14, 1930, E. C. Van Dyke, 2♂, CAS.

This western species is one of the few in the *californica* group having a distinguishing character in the female. The male is readily distinguished from other members of the genus by the "neck" on the terminal plate and the swan's-neck hook articulating with it.

Sialis americana (Rambur)

Sembris americana Rambur (1842, p. 447).

Sialis ferrugineus Walker (1853, p. 195).

Sialis americana Hagen (1861, p. 188); Banks (1892, p. 357); Davis (1903, p. 450).

Protosialis americana Van der Woele (1909, p. 263; 1910, p. 75).

MALE.—Length 12 mm. Yellowish orange with the antannae, eyes, tibiae and tarsi almost black. Abdomen, posterior half of head, palpi and margins of pronotum suffused with blackish. Wings and veins yellowish orange.

Head dull with fine reticulations, concave around branching of epicranial stem. Front wing with five to seven supernumerary cross-veins in costal cell.

Abdomen and genitalia as in figs. 10 and 22. Ninth sternite produced caudad into a fairly long, truncate sclerite, clothed with sparse but moderately long pubescence and covering bases of lateral plates. Lateral plates small and triangular, the posterolateral portion angulate; appearing as appendages of the ninth sternite and not appressed on the meson. Genital plate forming a broad collar in front of terminal plate, and bearing a pair of broad, straight arms. These appear in fig. 22a, so that at first glance they appear as appendages of the terminal plate. Terminal plate round, the margins clothed with long setae, the apex with a small, semicircular incision.

FEMALE.—Size, color and general characteristics as in male. Seventh sternite, fig. 58, rectangular, neither larger nor more heavily sclerotized than the preceding segments; produced into a convex area on the meson; the entire segment together with

the eighth clothed with sparse but fairly long setae. Eighth sternite small and rectangular, the apical margin with a diamond-shaped shining area on the meson. Ninth sternite and bursa copulatrix indistinct in cleared specimens.

MARYLAND.—Laurel: June 22, 1912, E. B. Marshall, 1♂, NM.

OHIO.—Kent: June 18-22, 1900, R. C. Osburn, 2♂, 1♀, OSU; 2♂, 1♀, INHS.

The character of "black antennae" mentioned for *americana* by Van der Woele and for *ferrugineus* by Walker indicate that both names apply to the species herein described. It is possible, however, that Rambur's name *americana* could apply to the species *glabella* described herein as new. At the present time it seems better to follow the synonymy of previous authors.

Sialis glabella—NEW SPECIES

MALE.—Length 12 mm. Yellowish orange with the following exceptions: mesal two-thirds of vertex dark reddish brown with the usual bars and spots yellow, forming a regular pattern, fig. 49; dorsum of abdomen dark brown; sutures of mouthparts, thorax and legs light brown; and antennae, tibiae and tarsi slightly darker and browner than body ground color.

Head and pronotum smooth and polished, without any trace of sculpturing, clothed with very fine short pubescence; concave at branching of epicranial stem. Venation as in *americana*.

Abdomen and genitalia very similar to those of *americana* with the following differences: Ninth sternite only two-thirds as long, lateral plates longer and closer together, terminal plate identical, genital plate with a pair of long arms whose apical half is markedly narrowed, fig. 45.

FEMALE.—Size, color and general structure as in male, abdomen as in *americana*.

Holotype, male.—Mt. Carmel, Ill.: May 28, 1884, sweeping (acc. no. 1796), INHS.

Allotype, female.—Same data as holotype.

Paratypes. ILLINOIS.—Muncie: June 16, 1908, H. E. Ewing, 1♀, INHS.

This species looks very much like *americana*, but is easily distinguished from it by the shining, impunctate head, paler antennae and tibiae, and the narrowed genital arms of the male. Both records are points on the Wabash river drainage system.

Sialis velata—NEW SPECIES

MALE.—Similar to *itasca*, p. 72, in size,

color and general structure. The wings are on the average darker and only rarely present a banded appearance.

Abdomen and genitalia, figs. 29 and 35, similar to *itasca* with these differences: ninth sternite with apical margin rounded; lateral plates shorter, their apex broad and rounded and the lateral margin not angulate; genital hooks bending just below level of terminal plate and with a slender basal appendage which runs some distance from top prong; terminal plate longer, raised more than its width from the sclerite at its base.

FEMALE.—Apparently identical with that of *itasca*.

Holotype, male.—Houghton lake, Mich.: June 15-18, 1935, T. H. Frison, INHS.

Allotype, female.—Same data, collected *in coitu* with holotype.

Paratypes. ALBERTA.—Medicine Hat: May 24, 1923, 1♂, CNM.

BRITISH COLUMBIA.—OSOYOOS: May 20-21, 1923, C. B. Garrett, 3♂, 4♀, CNM; 3♂, 1♀, INHS.

ILLINOIS.—Calvin: April 14, 1930, Frison & Ross, 3♂, INHS. Charleston: April 23, 1932, Ross & Mohr, 1♂, INHS. Dixon Springs: April 21, 1935, T. H. Frison, 2♂, INHS. Dubois: April 24, 1919, creek valley, 1♂, INHS. Havana, Illinois river front: April 27, 1896, C. A. Hart, 3♂, INHS. Homer: May 6, 1911, 1♂, INHS. Mt. Carmel: April 19, 1932, Ross & Mohr, 1♂, INHS. New Columbia, Clifty creek: April 22, 1932, Ross & Mohr, 1♂, INHS. Parker: April 17, 1914, 1♂, INHS. Rock Island: May 10, 1934, Ross & Mohr, 1♂, INHS; May 16, 1931, 2♂, INHS. Shawneetown: April 26, 1926, Frison & Auden, 1♂, 1♀, INHS. Spring Grove, along Nippersink creek: May 14, 1936, Ross & Mohr, 5♂, 12♀, INHS. Urbana: May 22, 1923, 1♂, INHS; April 26, 1890, C. A. Hart, at light, 1♂, INHS. Vienna: April 21, 1932, Ross & Mohr, 1♂, INHS.

KANSAS.—Douglas county: April 14, 1922, R. Guentert, 34♂, 10♀, KU; 7♂, 5♀, INHS; April 1923, R. H. Beamer, 3♂, KU. Manhattan: April 2, 1932, F. E. Whitehead, 1♂, KAS; April 18, 1930, A. Audant, 1♂, KAS. McPherson county: April 16, 1932, 1♂, KAS. Onaga: May 30, 1926, 1♂, INHS. Riley county: April 29, Popenoe, 1♂, KAS.

MAINE.—Waldoboro: May 1902, Lovell, 1♂, CU.

MANITOBA.—Aweme: June 14, 1912, N. Criddle, 1♂, CNM; May 27, 1925, R. M. White, 1♂, INHS; 1♀, CNM; June 13, 1926, N. Criddle, 1♂, CNM; June 4, 1926, R. D. Bird, 3♂, CNM; Criddle, 1♂, CU.

MARYLAND.—Plummer's Island: April 17-22, 1903, W. V. Warner, 2♂, 2♀, NM; April 22, 1915, J. C. Crawford, 2♂, INHS; April 18, 1915, H. S. Barber, 1♂, NM; May, 1♂, 1♀, NM.

MASSACHUSETTS.—Cambridge: May 28, 1900, S. Henshaw, 4♂, MCZ. Lake Cochicuate: May 28, 1♂, INHS. Wellesley: May 1895, A. P. Morse, 5♂, MCZ.

MICHIGAN.—Ann Arbor, Washtenaw county: May 16, 1917, 1♂, MMZ. Detroit: May 5, H. G. Hubbard, 1♂, mcz; May 27, 1897, 1♀, AM; 1♂, mcz; May, 2♂, 1♀, mcz. Grayling, power dam on Au Sable river: June 17, 1935, T. H. Frison, 1♂, INHS. Higgins lake, Crawford county: June 19, 1932, G. Kelker, 1♂, 2♀, MMZ. Houghton lake: June 15–18, 1935, T. H. Frison, 2 mating pairs, 22♂, 48♀, INHS. Margurite lake: May 23, 1936, Frison & Ross, 2 mating pairs, 391♂, 662♀, INHS. Mio, along Au Sable river: May 21, 1936, Frison & Ross, 35♂, 3♀, INHS. Omer, along Rifle river: May 21, 1936, Frison & Ross, 1♂, 1♀, INHS. Wash-tenaw county: May 22, 1930, 1♂, MMZ.

MINNESOTA.—Big Cormorant lake: May 14, 1900, R. C. Osborn, 1♂, 2♀, OSU. Coon creek: May 20, 1933, D. J. Pletsch, 2♂, UM. Itasca county: 1♂, UM. Itasca Park: May 30, 1932, C. H. Hoffman, 14♂, 1♀, UM; 5♂, INHS; June 13, 1928, L. W. Orr, 3♂, 2♀, UM; June 9, 1934, W. A. Riley, 1♀, UM.

MISSOURI.—Columbia: April 21, 1905, 1♂, INHS.

NEW HAMPSHIRE.—Three-mile island: June 2, 1♂, mcz.

NEW YORK.—Cortland county, Labrador lake: May 14, 1921, 2♂, CV. Crosby, Yates county: May 18, 1918, 1♂, CV. Cranberry lake: June 23, 1919, J. C. Clark, 1♂, CV; June 26, 1920, C. J. Drake, 1♂, INHS. Litchfield: May, 1903, 1♂, AM. Oswego: May, 1894, 1♂, NM. Peru: May, 1914, 2♂, CV. Stanley: May 1920, 1♂, CV. Syracuse: Cook & Collins, 1♂, NM. Westport: May 1921, 1♂, INHS; May 20, 1922, 4♂, 1♀, AM; 1♂, 1♀, INHS.

NORTH DAKOTA.—Fargo: June, 1♂, INHS.

ONTARIO.—Casselman: May 23, 1♂, CNM; April 21, 1904, 1♂, CNM. Jock river: May 23, 1927, G. S. Walley, 1♂, INHS. Maitland: June 12, 1931, L. J. Milne, 4♂, 11♀, CNM, 1♂, 1♀, INHS. Ottawa, Rideau river: May 27, 1930, L. J. Milne, 1♂, CNM; June 9, 1920, J. McDunnough, 2♂, CNM; May 29, 1920, J. McDunnough, 2♂, 3♀, CNM; 1♂, 1♀, INHS. Rat Portage island: June, 1905, J. C. Bradley, 1♂, CV. Sand lake: July 3, 1926, F. P. Ide, 3♂, CNM. Sioux Lookout: June 25, 1929, J. Russell, 1♂, CNM. Southampton: June 20, 1931, G. S. Walley, 1♂, CNM. Trenton: May 5, 1900, 1♂, CNM.

QUEBEC.—Knowlton: June 21, 1929, L. J. Milne, 1♂, CNM. Lachine: June 8–9, 1926, F. P. Ide, 11♂, 3♀, CNM. La Prairie: June 14, 1927, G. S. Walley, 4♂, 4♀, CNM; 1♂, 3♀, INHS; June 9, 1926, F. P. Ide, 2♂, CNM.

SASKATCHEWAN.—Schudder, 3♂, 1♀, INHS. Saskatchewan river: 1♂, mcz.

TEXAS.—Kerrville: March 24, 1906, F. C. Pratt, 1♂, INHS.

VIRGINIA.—Great Falls: April 19–30, 6♂, mcz; May, 1♂, NM; May 2, 1916, 1♂, NM.

WASHINGTON, D. C.—May, Ashmead, 2♂, NM; Apr. 3, 1♀, NM; Apr. 20, 1♂, mcz; Apr. 29, 1♂, NM.

WEST VIRGINIA.—Millville: Apr., 1921, 1♂, INHS.

WISCONSIN.—Washington Island, Door county: June 7, 1905, 1♂, 1♀, mcz. Sturgeon bay: June 7, 1929, A. Granovsky, 2♂, 6♀, UW; 1♂, 2♀, INHS. Madison: May 1934, 1♂, UW;

May 31, 1912, A. C. Burrill, 1♂, UW. Lake Mendota: June 7, 1910, J. G. Sanders, 1♂, UW. Trout lake: June 1, 1934, H. L. Chada, 1♂, UW.

Sialis itasca—NEW SPECIES

MALE.—Length 11 mm. Black with these exceptions: head with bars and spots, narrow margin around eye and malar space orange. Wings dark brown with apical two-thirds varying from slightly paler to completely hyaline. Specimens of this type present a striking banded appearance when the wings are spread.

GENERAL STRUCTURE.—Dorsum of head dull with coarse and abundant shagreening. Vertex usually concave along meson, but sometimes robust and even slightly convex. Front wing with about 10 accessory cross-veins in costal area, remainder of venation normal.

Abdomen and genitalia as in figs. 28 and 34. Ninth sternite narrow, apical margin angular. Lateral lobes long, their lateral margins more or less angular; apex bluntly pointed so that the apical portion is somewhat triangular. Genital plate collarlike, situated below terminal plate, and giving rise to a pair of long, bent arms, fig. 28a, projecting forward almost to the ninth sternite; the two arms are closely appressed, usually appearing as one; each arm angles forward just above level of terminal plate and at its base has a lobe thicker than the arm and running very close to it. Terminal plate, fig. 28b, with a wide angular incision at apex; the plate rising less than its width above the sclerite at its base.

FEMALE.—Length 13 mm. Color and general structure as in male.

Abdomen and genitalia as in fig. 54. Seventh sternite wider than long, only slightly arcuate at apex. Eighth flat, wide and narrow, with a median shallow depression. Apex of bursa copulatrix sclerotized and rounded, with a long straight fingerlike process on the ventral side at extreme tip, figs. 46, 54.

Holotype, male.—Momence, Ill., along Kankakee river: June 1, 1937, B. D. Burks, INHS.

Allotype, female.—Same data as holotype.

Paratypes.—ILLINOIS.—Charleston: June 19, 1931, H. H. Ross, INHS. Maywood, DesPlaines river: June 7, 1912, 1♂, INHS. Momence: same data as holotype, 2♂, 1♀, INHS. White Heath: June 9, 1929, C. O. Goff, 1♂, INHS; June 18, 1906, woods, 1♂, INHS. White Pine State Park: May 30, 1936, Ross, 1♂, INHS.

KANSAS.—Manhattan: May 20, 1925, R. E. Sears, 1♂, INHS.

MICHIGAN.—Douglas lake: July 4, 1927, L. K. Gloyd, 1♂, INHS.

MISSOURI.—Bryant's Point: May 13–15, 1915, P. Bartsch, 1♂, INHS; 2♂, NM.

NEW YORK.—Cranberry lake: July 8, 1920, C. J. Drake, 1♂, cu. Ithaca: June 20, 1907, 1♂, INHS; June 12, 1914, 1♂, INHS; June 12–14, 1915, 2♂, cu; 2♂, INHS; June 17, 1916, 1♂, cu; June 25, 1916, 1♂, cu; June 16, 1915, 1♂, cu; 2♂, INHS; June 12, 1913, 1♂, cu; May 18, 1♂, cu. Rochester Junction: June 9, 1914, M. D. Leonard, 1♂, cu.

NORTH DAKOTA.—Fargo: June 3, 1901, R. C. Osborn, 1♂, OSU.

OHIO.—Huron: June 24, 1914, 1♂, 13♀, cu; 1♂, 4♀, INHS. Marietta: 1♂, MCZ.

ONTARIO.—Marquint park: June 18, 1922, J. McDunnough, 1♂, CNM. Britannia: June 23, 1920, G. Beaulieu, 3♂, 2♀, CNM; 2♂, 2♀, INHS. Ottawa West: June 21, 1920, C. B. Hutchings, 1♂, CNM; 1♂, INHS.

PENNSYLVANIA.—Candy Hill: May 28, 1♂, INHS. Harrisburg: May 30, 2♂, INHS. West Chester: May 19, 1924, 1♂, cu; 1♂, INHS; 1♂, ANS.

QUEBEC.—Lacolle: July 5, 1928, G. H. Hammond, 1♂, CNM. Laprairie: June 17, 1925, F. P. Ide, 3♂, 2♀, CNM; 2♂, 2♀, INHS.

VIRGINIA.—Dyke: May 28, 1915, W. L. McAtee, 1♂, NM. Great Falls: May 25, N. Banks, 10♂, MCZ; 4♂, INHS; June 3, 1♂, MCZ; June 18, 1♂, MCZ; June 5, 1♂, MCZ. Mt. Vernon: June 6, 1915, W. L. McAtee, 1♂, INHS.

WASHINGTON, D. C.—F. C. Pratt, 1♂, NM.

Sialis infumata Newman

Sialis infumata Newman (1838, p. 500).

MALE.—Similar in size, color and general structure to *velata* and *itasca*. Differs in genitalia as follows, figs. 30 and 36: ninth sternite narrow and slightly angulate at apex; lateral lobes long, the apical fourth constricted and forming a large round knob; genital hooks long and slender, bending at half the height of the terminal plate, the appendage near their base ovate and short, no longer than a third of the horizontal portion of the hook; terminal plate twice as high as wide, its sides convex and narrowing towards apex, the latter with a shallow, narrow incision on the meson.

FEMALE.—Similar to that of *velata*, differing only in the structure of the eighth sternite, fig. 60. This is fonger and rectangular, with a narrow V-shaped depression extending along the meson of the entire segment. The halves have the apical half somewhat raised into a lobe and the posterior half flat.

Holotype, female.—Trenton Falls, N. J.: Doubleday, BM.

Allotype, male.—Wilmington, Ill., along Kankakee river: May 17, 1935, H. H. Ross, INHS.

ILLINOIS.—Algonquin: May 12, 1906, W. A. Nason, 2♂, 1♀, INHS. Cedar lake: 3♂, 1♀, INHS; 3♂, OSU. Easton, central ditch: May 1, 1914, 1♂, INHS. Galena: 1♂, 1♀, MCZ. Oakwood: April 26, 1936, Eugene Ray, 2♂, INHS. Rantoul: April 24, 1929, Frison & Ross, 1♂, INHS. Wilmington: May 12, 1935, Frison & Ross, 3♂, INHS; May 17, 1935, H. H. Ross, 3♂, 1♀, INHS.

KANSAS.—Manhattan: April 30, 1933, D. E. Musser, 2♂, INHS; April 7, 1930, R. H. Painter, 1♂, KAS; May 15, 1933, 1♂, KAS; Sept. 10, 1932, M. W. Allen, 2♂, KAS.

MICHIGAN.—Vassar branch of Cass river: May 20, 1936, Frison & Ross, 1♂, INHS.

NEW YORK.—Ithaca: May 3–25, 4♂, 9♀, INHS; 2♂, 15♀, cu; inlet valley, May 3, 1913, 1♂, cu. Syracuse: Cook & Collins, 1♂, NM.

OHIO.—Columbus: April 23, 1899, R. C. Osborn, 1♂, OSU.

PENNSYLVANIA.—Harrisburg: May 11, 1909, 1♂, INHS. Manayunk: April 26, 1♂, ANS.

The identity of this species is still a trifle uncertain. D. E. Kimmins of the British Museum has kindly compared specimens with the female type and says that it agrees most closely with this determination. The differentiation of the females of the *infumata-itasca-velata* group, however, is not as definite as might be wished. Mr. Kimmins, however, cleared the abdomen of the type, so that the present treatment is as satisfactory as possible under the circumstances.

The bibliography of this species includes only the original description. The other references to the species in literature cannot be placed with certainty due to the confusion of so many species under this name by various authors.

Sialis concava Banks

Sialis concava Banks (1897, p. 22)

MALE.—Similar in size, color and general structure to *infumata* and *itasca*. Differs in genitalia as follows, figs. 33 and 37: lateral plates smaller, more or less triangular, flat and angled at apex; genital hooks, fig. 33a, long, slender for their whole length, angled at half or less the height of the terminal plate, and without an appendage at their base; terminal plate, fig. 33b, long, slender, tapering almost to apex, which is slightly widened and beset with a cluster of fairly long setae.

FEMALE.—Unknown.

Holotype, male.—Ithaca, N. Y., MCZ.

MARYLAND.—1♂, INHS.

NEW YORK.—Ithaca: May 29, 1913, 1♂, INHS.

ONTARIO.—Power Glen: June 25, 1926, G. S. Walley, 1♂, CNM.

The type has the genitalia expanded so that the parts are readily seen.

Sialis hasta—NEW SPECIES

MALE.—Similar in size, color and general structure to *infumata*. Differs in genitalia as follows, figs. 31 and 38: ninth sternite broad, apical margin evenly rounded; lateral plates broad, their apex wide and evenly rounded; genital hooks, fig. 31a, broad at base, tapering beyond bend to a point, very low, the outer margin of the bend angular; appendage at base of hooks triangular, short and with an angular apex; terminal plate quadrate, fig. 31b, each lateral corner prolonged into a long, straight apical process, these processes surmounted by a tuft of setae and separated by a distance almost equal to their own length.

FEMALE.—Similar in color and general structure to male. Genitalia very similar to those of *infumata*, fig. 54, differing as follows: seventh sternite with only apical half sclerotized, apical margin broadly and shallowly emarginate, eighth sternite with antero-lateral portions slightly more rounded than in fig. 54.

Holotype, male.—Lovells, Mich., along Au Sable river: May 22, 1936, Frison & Ross, INHS.

Allotype, female.—Same data as holotype.

Paratypes. MICHIGAN.—Hale, along Au Gres river: May 21, 1936, Frison & Ross, 1♂, INHS. Lovells: 4♂, 8♀, same data as holotype; May 24, 1936, J. W. Leonard, 1♂, 15♀, INHS. Whittemore along Johnson creek: May 21, 1936, Frison & Ross, 2♂, INHS.

PENNSYLVANIA.—Allegheny county, 1♂, CM; 1♂, INHS. Washington county, 1♂, CM.

Sialis mohri—NEW SPECIES

MALE.—Similar in size and color to *infumata*. Differs in general structure as follows: median area of vertex concave, velvety in appearance due to fine setae and punctures; costal area of front wing with six to 10 accessory cross-veins, averaging seven or eight.

Abdomen and genitalia as in figs. 32 and 39. Ninth sternite angular on meson, not very long; lateral lobes broad, narrowed at apex to a rounded point; genital plate, fig. 32a, broad at base, with a long, thin, curving blade three times as long as the basal portion; terminal plate, fig. 32b, more or less heartshaped, bearing a pair of long arms at apex which come off at right angles to the main sclerite, and curve slightly upward; each arm is stocky at its

base and tapers to a fine point, is very heavily sclerotized, and sinuate, fused with each other at base, and beyond that separate.

FEMALE.—Similar to male except for genitalia and larger size. Abdomen and genitalia, fig. 56, very characteristic of species: seventh sternite as for genus; eighth very narrow on meson, the lateral portions more or less triangular; apparent ninth sternite sclerotized, fitting within the cut-out margin of the eighth, having a sclerotized carina along the meson at apex, the entire segment somewhat diamond shaped.

Holotype, male.—Boulder Junction, Wis., on Trout river: June 20, 1934, Frison & Mohr, INHS.

Allotype, female.—Same data as holotype, and collected *in coitu* with it.

Paratypes. CONNECTICUT.—New London: June 23, 1917, R. C. Osborn, 2♂, OSU.

ILLINOIS.—Algonquin: May 20, 1906, W. A. Nason, 5♂, 2♀, INHS; May 29, 1909, 1♀, INHS. Antioch; Channel lake: June 5, 1919, T. H. Frison, 2♂, 2♀, INHS; May 16, 1936, Ross & Mohr, 2♂, 9♀, INHS. Near Cooperstown, Illinois river: May 20, 1932, Ross & Mohr, 1♂, INHS. Dubois: April 24, 1914, Creek valley, 5♂, 7♀, INHS. Fox Lake, along lake: May 15, 1936, Ross & Mohr, 21♂, 60♀, INHS; May 28, 1936, Ross, 2♂, 10♀, INHS; May 28, 1936, Ross, 2♂, INHS. Glenn Ellyn: May 30, 1908, W. J. Gerhard, 2♂, FM; 1♂, INHS. Grays lake: May 26, 1936, Ross, 3♂, 7♀, INHS. Havana, Illinois river: June 3, 1933, Mohr, 1♂, INHS; May 4, 1895, Hart, 1♂, 1♀, INHS; May 8, 1932, Mohr, 1♂, 8♀, INHS; May, 1895, 1♀, INHS; May 21, 1895, 2♀, INHS; May 21, 1932, Ross & Mohr, 3♂, 8♀, INHS; April 27–30, 1896, C. A. Hart, 2♂, 3♀, INHS. Henry, Lake Senawhine: May 30, 1932, D. H. Thompson, 1♂, 3♀, INHS. Kankakee: June 6, 1935, Ross & Mohr, 1♂, INHS. Lake Forest: May 1905, J. G. Needham, 1♂, 1♀, CU. Meredosia, Illinois river: May 15, 1934, Frison & Mohr, 2♂, 3♀, INHS. Paris: 1931, 1♂, INHS. Pistakee lake: June 12, 1936, 1♂, 1♀, INHS. Rockford: W. Bebb, 1♂, INHS; June 10, 1897, 1♀, INHS. Rock Island, near Rock river: 1863, Walsh, 1♀, MCZ; 1♀, INHS; May 18, 1934, Ross & Mohr, 1♀, INHS; Walsh, 1♀, MCZ. South Chicago, Calumet river: June 9, 1880, 3♀, INHS. Wilmington, Kankakee river: May 17, 1935, H. H. Ross, 1♂, INHS.

INDIANA.—Wolf lake: May 26, 1912, A. B. Wolcott, 3♂, 1♀, FM; 2♂, INHS.

KENTUCKY.—Near Mammoth Cave: May 2, 1874, J. G. S., 1♂, MCZ; 1♂, INHS.

MASSACHUSETTS.—Cambridge: May 28, 1900, S. Henshaw, 2♂, MCZ; 1♂, KAS. Framingham: May 23, 1930, C. A. Frost, 1♂, INHS. Haverhill: June 7, 1866, 1♀, MCZ. Minot county: June 10, 1871, Sharon, 2♂, 1♀, MCZ. Holliston: May, 3♂, MCZ. Wellesley: May 1900, A. P. Morse, 8♂, 3♀, MCZ.

MICHIGAN.—Ann Arbor, Washtenaw county: May 22, 1919, F. M. Gaige, 1♂, MMZ. Bryant

bog: July 12, 1924, H. B. Hungerford, 1♀, KU. Cedarville: June 1929, 1♂, CM. Cheboygan county: July 4 and 24, 1935, D. S. Shetter, 1♂, 1♀, MMZ. Clinton along Raisin river: May 19, 1936, Frison & Ross, 1♂, INHS. Detroit: June 1874, 1♂, 4♀, MCZ. Douglas lake: July 3, 1927, L. K. Gloyd, 3♂, KAS; July 8, 1929, H. B. Hungerford, 5♀, KU; 2♀, INHS; July 20, 1926, H. B. Hungerford, 2♀, KU; June 6, 1925, Charles Martin, 1♂, 1♀, KU; 1♂, 1♀, INHS; June 22-25, 1926, Charles Martin, 3♀, KU; June 25, 1928, Charles Martin, 1♀, KU. Fontenalis Run, Burt lake: July 7, 1926, H. B. Hungerford, 1♂, INHS; 1♀, KU. Houghton lake: June 15-18, 1935, T. H. Frison, 1 mating pair, 188♂, 165♀, INHS. Mill lake, Washtenaw county: May 24, 1919, R. F. Hussey, 1♂ MMZ. Mio, along Au Sable river: May 21, 1936, Frison & Ross, 6♂, 1♀, INHS. Portage lake, Washtenaw county: May 30, 1905, N. A. Wood, 8♂, 3♀, MMZ.

MINNESOTA.—Bemiji: June 19, 1932, J. Karlovich, 2♂, INHS. Frontenac, shore of Lake Pepin: May 25, 1930, W. C. Stehr, 5♂, 1♀, UM; 2♂, 1♀, INHS; May 29, 1930, C. E. Mickel, 2♂, 2♀, UM; May 22, 1932, Theodore Olson, 8♀, UM; 2♀, INHS. Goodhue county: May 25, 1930, Carl T. Schmidt, 6♂, UM. Hennepin county: May 30, 1921, A. T. Hertig, 2♀, UM. Lake Superior: 1♂, 1♀, UM. Minneapolis: June 7, 1916, 1♂, INHS. Ramsey county, Lake Johanna: May 17, 1922, Wm. E. Hoffman, 2♀, UM; June 17, 1920, H. H. Knight, 1♂, UM. Red Lake county: June 12, 1920, Jonson, 1♀, UM. Staples: June 22, 1924, C. B. Philip, 2♀, UM.

NEW ENGLAND.—A. Agassiz, 1♀, INHS.

NEW JERSEY.—Lakehurst: May 24, 1914, R. C. Osborn, 1♂, OSU. Lake Hopatcong: May 30, 2♂, 1♀, AM. Newfoundland: May, R. C. Osburn, 1♀, OSU.

NEW YORK.—Nepperhan: May 27, 1905, 2♂, CU; 1♂, INHS. Mosholu: 6♂, 4♀, AM; 1♂, 1♀, INHS.

OHIO.—Sandusky, Cedar Point: June 22, 1913, 2♂, 1♀, OSU; June 20, 1912, 1♂, OSU; 1♂, CU.

ONTARIO.—Honey Harbor: June 4 and 6, 1932, G. S. Walley, 2♂, 1♀, CNM; Ottawa West: June 21, 1920, C. B. Hutchings, 1♀, CNM. Point Pelee: June 8, 1925, G. S. Walley, 4♂, 1♀, CNM; 2♂, 1♀, INHS. June 1, island, 1♂, 1♀, CNM. Rondeau park: June 13, 1929, G. S. Walley, 1♂, 1♀, CNM.

NEW BRUNSWICK.—Frederickton: 192-, 1♀, CNM. Greys Mills: June 1, 1921, R. P. G., 2♀, CNM.

PENNSYLVANIA.—Huntsville: May 23, 1918, M. W. Eddy, 1♂, KAS. Mt. Pocono: June 9, 1906, A. S. Calvert, 1♀, ANS. Poyntelle: June 17, 1904, 1♂, ANS. Wilkes Barre: May 1918, J. N. Knull, 1♂, MCZ, 1♂, INHS.

QUEBEC.—Knowlton: June 11, 1930, L. J. Milne, 3♂, 60♀, CNM; 1♂, 4♀, INHS.

WISCONSIN.—Chetek: June 6, 1925, 1♀, UM. Sawyer, Plum lake: June 20, 1931, Orlando Park, 1♂, 2♀, INHS. Delavan: April 27, 1916, G. A. Chandler, 1♂, UW. Madison: June 9, 1931, 1♂, INHS; June 10, 1932, 2♀, UW; June 1, 1912, 1♂, UW; June 13, 1♂, UW; June 6,

1927, 1♀, INHS; 1911, 1♂, INHS; 1914, 1♀, UW. Sturgeon Bay: June 7, 1929, A. Granovsky, 1♀, UW. Trout lake: May 6, 1934, H. L. Chada, 1♂, UW.

Sialis rotunda Banks

Sialis rotunda Banks (1920, p. 327).

MALE.—Length 12 mm. Color as for *vagans*, p. 76. General structure very similar to *vagans* with the following radical difference: head between eyes raised, forming a ridge bearing a blunt point surmounted by a conspicuous, close tuft of black setae, fig. 43; middle of clypeus with a similar tuft of setae.

Abdomen and genitalia as in figs. 13 and 24. Ninth sternite produced into a large flap, somewhat orbicular, clothed with long setae. Lateral plates long, the apical portion narrower than the base, the apical margin truncate or emarginate in the middle; in the middle of the basal portion there is a small, rounded protuberance surmounted by a conspicuous group of setae, fig. 24a. Genital plate large and wide; the genital hooks arising at right angles to the apical margin, slender, gracefully curved and touching at base and apex; the apical margin of the plate upturned to form a thin, extensive lamella along the entire apex of the plate. Terminal plate, fig. 25b, flat and triangular with a narrow notch dividing the tip.

FEMALE.—Length 14 mm. Color as for the male. Head, fig. 44, lacking the prominent frontal horn but with a low but distinct elevation between antennae above clypeus. Center of this hump and clypeus each with a small cluster of dark setae.

Abdomen and genitalia as in fig. 55. Seventh segment rectangular. Eighth fairly small, angulate and produced posteriorly, mesal depression oval and large. Basal portion of segment semimembranous, apex strongly sclerotized and clothed with fairly short setae. Bursa copulatrix entirely amorphous.

Lectotype, male, by present designation.—Bon Accord, B. C.: May 20, type # 10845, MCZ.

Lectoallotype, female.—Same data as lectotype.

BRITISH COLUMBIA.—Agassiz: April 4 to May 27, 4♂, 3♀, CNM; 3♂, 1♀, INHS. Bear Lake: July 20, 1903, R. P. Currie, 2♂, NM; 1♂, INHS. Cultus lake, Chilliwack: June 5, 1929, H. H. Ross, 1♂, INHS.

OREGON.—Aalsea Mt.: May 3, 1936, R. G. Rosentel, oac. Blodgett: June 29, 1927, Darlington, 1♂, MCZ. Cannon Beach: June 14, 1927, E. C. Van Dyke, 1♀, INHS. Corvallis: Mar. 29, to July 6, 12♂, 13♀, oac; 6♂, 6♀,

INHS. Crater lake, 7000 feet elevation: July 18, 1922, E. C. Van Dyke, 1♂, CAS. East lake: July 8, 1933, R. E. Dimick, 1♀, OAC; 1♀, INHS. Independence: June 8, 1934, N. P. Larson, 1♂, 1♀, OAC. Lacombe, South Fork Crabtree creek: March 21, 1934, Gray & Edwards, 7♂, 3♀, OAC; 5♂, 2♀, INHS; Apr. 10, 1936, OAC. Lebanon, Santiam river: March 21, 1934, R. E. Dimick, 1♂, OAC. Marshfield: March 22, 1931, 1♀, INHS. Mt. Hood: July 1, 1927, Darlington, 1♂, 1♀, MCZ. Mt. Jefferson, 3000 feet elevation: July 1907, J. C. Bridwell, 2♀, INHS. Olney: June 15, 1925, E. C. Van Dyke, 1♀, CAS. Portland: 1927, E. Walley Jones, 1♀, UM. Scott lake, Three Sisters, 4650 feet elevation: July 17, 1927, Scullen, 1♂, OAC; July 12, 1936, R. E. Rieder, OAC. Slide lake, Grant county, 7200 feet elevation: July 16, 1936, H. A. Scullen, 1♂, OAC. Strawberry lake, Grant county, 6400 feet elevation: July 17, 1936, H. A. Scullen, 2♀, OAC; 1♂, 1♀, INHS. Valsetz lake: April 5, 1934, J. Schuh, 9♂, 2♀, OAC; 5♂, 2♀, INHS. Wauhink lake, Lane county: May 19, 1933, R. E. Dimick, 2♂, 1♀, OAC; 2♂, INHS.

WASHINGTON.—Bellingham: June 8, 1932, 1♀, OAC. Seattle: June 19, 1920, E. C. Van Dyke, 1♀, CAS.

Sialis nevadensis Davis

Sialis nevadensis Davis (1903, p. 450).

Sialis morrisoni Davis (1903, p. 450).

MALE.—Length 15 mm. Black with the following exceptions: head usually with an orange band covering lateral area of head and posterior half of vertex, and legs sometimes partly or entirely suffused with reddish. Wings dark brown, almost black.

GENERAL STRUCTURE.—Head and prothorax dull with scattered shagreening, sometimes shining; front and adjacent part of vertex evenly concave. Front wing with eight or 10 accessory cross-veins, remainder of venation normal for genus.

Abdomen and genitalia as in figs. 15 and 27. Ninth sternite produced into a large flap rounded at apex and clothed with long setae. Lateral plates long, with a fingerlike lobe on mesal side at base, fig. 27a; apex armed with a stout and sharp tooth curving mesad. Genital plate small, fairly high, and forming a stubby, sharp tooth on meson; its anterior face membranous, bisected on meson by a linear sclerotized strip. Terminal plate produced at apex into a pair of divergent arms; the inner margin of these is membranous, swelling in treated specimens as illustrated, but in dry specimens sometimes collapsing into a narrow, cylindrical structure.

FEMALE.—Length 18 mm. Color and general structure as in male, except that the head is usually shining and impunctate.

Abdomen and genitalia as in figs. 61 to 63. Seventh and eighth sternites heavily sclerotized, clothed with moderately long setae. Seventh sternite almost as long as wide, apical margin sinuate and produced on the meson. Eighth sternite, fig. 63, rectangular, divided on the meson for two-thirds its length by a narrow, deep fissure, forming almost quadrate halves. Tip of bursa copulatrix well sclerotized, figs. 61 and 62, and bearing a large knob.

Types, male and female.—Reno, Nev.: NM. The male has the genitalia showing to allow certain diagnosis.

Paratypes. NEVADA.—RENO: 2♂, 1♀, MCZ.

The type of *morrisoni* is a female from Reno, Nev., which shows the characteristic genital plate, MCZ.

CALIFORNIA. — Carrville, Trinity county, 2400–2500 feet elevation: June 7–9, 1935, E. C. Van Dyke, 1♂, 2♀, CAS; 1♀, INHS. Meadow valley, Plumas county, 3500–4000 feet elevation: June 10, 1934, E. C. Van Dyke, 1♂, CAS; 1♂, INHS. Mt. Lassen, 7000 feet elevation: July 14, 1935, E. P. Van Duzee, 1♂, CAS. Mt. Shasta: June 23, 1914, 1♂, INHS; 1♀, CU.

Sialis vagans—NEW SPECIES

MALE.—Length 11 mm. Black with only the usual marks on head yellowish. Wings almost black, sometimes with apical half or more almost hyaline, giving the wing a banded appearance.

GENERAL STRUCTURE.—Head dull with dense shagreening, front sloping to clypeus. Vertex slightly concave along meson. Pronotum shagreened. Front wings with about 10 accessory cross-veins, radius 2 with two or three branches.

Abdomen and genitalia as in figs. 11 and 23. Ninth sternite forming a large flap covering the genitalia when folded in repose; apical margin rounded and very slightly notched on the meson; covered with fairly sparse, long setae. Lateral plates broad at base, tapering to a bluntly rounded apex, clothed with short setae. Genital plate broad, forming a wide collar in front of the terminal plate; produced at apex into a closely appressed pair of short, wide processes which are bent forward at their extremity to form a small "beak," fig. 23a. Terminal plate flat and triangular, the apex forming a small knob notched slightly on the meson, fig. 23b.

FEMALE.—Length 12 mm. Color and general structure identical with male.

Abdomen and genitalia as in fig. 57. Seventh sternite rectangular, its apical

margin gently rounded. Eighth sternite narrow, with a deep median groove, the two lateral areas raised into two ovate lobes clothed with moderately long setae. Ninth sternite membranous and almost transverse, the angle it forms on the meson very wide. Bursa copulatrix amorphous and membranous.

Holotype, male.—Columbia City, Ind., along Eel river: May 19, 1936, Frison & Ross, INHS.

Allotype, female.—Same data as holotype.

Paratypes, ILLINOIS.—Easton, central ditch: May 1, 1914, 1♂, INHS. Palos Park: June 3, 1934, W. J. Gerhard, 1♂, INHS; 1♀, FM. Spring Grove, along Nippersink creek: May 14, 1936, Ross & Mohr, 8♂, 2♀, INHS.

INDIANA.—19♂, 18♀, same data as holotype.

MAINE.—Norway: S. J. Smith, 3♂, MCZ (two are paratypes of *aequalis*). Waldoboro: May 28 to June 5, 1902, J. H. Lovell, 4♂, 1♀, CU; 1♂, INHS.

MASSACHUSETTS.—Boston: 1♂, AM; 2♂, INHS. Forest Hills: May 14, 1881, T. Henshaw, 1♂, MCZ. Holliston: June 5, N. Banks, 1♂, MCZ. Wellesley: May 11, 1911, A. P. Morse, 1♂, MCZ.

MICHIGAN.—Big Rapids, along Muskegon river: May 22, 1936, Frison & Ross, 1♀, INHS. Breedsville: June 1932, Nettie Fuller, 1♂, 1♀, NM. Bronson, along Prairie river: May 19, 1936, Frison & Ross, 6♂, 2♀, INHS. Goodrich, along Thread river: May 20, 1936, Frison & Ross, 5♂, INHS. Grayling, along Manistee river: May 22, 1936, Frison & Ross, 1♂, 4♀, INHS. Hale, along Au Gres river: May 21, 1936, Frison & Ross, 6♂, 1♀, INHS. Lovells along Au Sable river: May 22, 1936, Frison & Ross, 1♂, 1♀, INHS; May 24, 1936, J. W. Leonard, 4♂, MMZ. Vassar, along branch of Cass river: May 20, 1936, Frison & Ross, 4♂, 2♀, INHS. Whittemore, along Johnson creek: May 21, 1936, Frison & Ross, 1♂, INHS. Ypsilanti township, Washtenaw county: May 19, 1918, M. H. Hatch, 1♂, MMZ.

NEW BRUNSWICK.—Frederickton: 192-, 3♂, CNM; 2♂, INHS.

NEW HAMPSHIRE.—Durham: Weed & Fiske, 2♂, CU; 2♂, INHS.

NEW JERSEY.—Lakehurst: May 24, 1914, R. C. Osburn, 1♂, AM; 1♂, INHS; 3♂, OSU; May 31, 1912, 1♂, INHS.

NEW YORK.—New York: July 19, 1902, R. C. Osburn, 1♂, INHS.

NOVA SCOTIA.—Greene county: June 22, 1921, 1♂, MCZ.

ONTARIO.—Algonquin Park: June 18, 1922, J. McDunnough, 1♂, CNM; 1♂, INHS. Lake of Bays: June 22, 1920, J. McDunnough, 1♂, INHS. St. Davids: June 11, 1926, G. S. Walley, 1♂, CNM. Waubamic: July 10, 1915, H. S. Parish, 1♂, CU.

PENNSYLVANIA.—May 19, 1♂, ANS. West Chester: May 24, 1919, 1♂, CU.

QUEBEC.—Kazubazua: June 7-10, 1927, J. McDunnough, 1♂, CNM. Knowlton: July 21, 1929, L. J. Milne, 1♀, CNM; June 10, 1930, L. J. Milne, 2♂, 2♀, CNM; June 7, 1♂, INHS. South Bolton: June 16, 1928, J. A. Adams, 1♂, CNM.

WISCONSIN.—Spooner, along Namakagon river: June 5-6, 1936, Frison & Ross, 2♂, INHS.

Sialis aequalis Banks

Sialis aequalis Banks (1920, p. 326).

MALE.—Size, color and general structure similar to *vagans*. Differs only in details of genitalia, figs. 12 and 25, as follows: lateral plate slightly more pointed, the apex upturned, short and subconical; genital plate with a pair of pennantlike membranous flaps attached to sides at base: apical processes of genital plate long and slender, fig. 25a, the tip curved over almost at right angles to remainder of process; terminal plate large, flat and wide, fig. 25b, produced at apex into a pair of wide, remote lobes.

FEMALE.—Practically identical with that of *vagans*.

Lectotype, male, by present designation.—Falls Church, Va.: April 25, Nathan Banks, type #10843, MCZ.

MARYLAND.—Cabin John bridge: April 28, 1901, E. A. Schwartz, 1♂, NM.

NEW JERSEY.—Jamesburg: April 30, 1911, 1♂, AM.

PENNSYLVANIA.—Lansdowne, Delaware county, in woods: April 30, 1900, 1♂, ANS.

VIRGINIA.—Arlington: Ashmead, 1♂, NM; 1♂, INHS. Falls Church: April 13, 1♂, MCZ; May 25, N. Banks (cotype) 1♂, INHS. Vienna: April 18, 1915, W. L. McAtee, 3♂, 1♀, NM; 2♂, INHS.

NORTH CAROLINA.—Morganton: 1877, Morrison, 1♂, KAS.

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II. Descriptions of Plecoptera

with Special Reference to the Illinois Species

T. H. FRISON

RESULTS FROM NEW MATERIAL

SINCE publication of "The Stoneflies, or Plecoptera, of Illinois" (Frison 1935a), some effort has been expended to fill gaps in our knowledge which existed at that time. Particularly important in furthering our information was the discovery of an abundance of certain species of stonefly nymphs in the White river of Indiana, at a place not far from the Illinois boundary line. The collecting of this material and its subsequent rearing at Urbana has made possible (1) specific determination of three different nymphs previously named only to genera, (2) recognition of the previously unknown female of *Hydroperla varians* (Walsh), and (3) recognition of a new species of *Acroneuria*. These specific placements bring the total of Illinois stoneflies to 38, with the certainty that two additional species will be added by future studies, one a questionable identification of a female *Capnia* as *vernalis* Newport and the other an *Isoperla* represented as yet by a single nymph not placeable to species.

In addition to securing material of special interest to our Illinois studies, the SURVEY has been fortunate also in having material sent from various places in North America for determination. Most of these specimens have belonged to species previously described or comparatively well known. Some, however, have been found to be new to science and their description is presented. Others, too, are so little known to entomologists to date as to warrant the description of a previously unknown sex and additional comments pertaining to distribution or matters of nomenclature.

The material upon which this paper is based has been obtained in part by the field work of various SURVEY entomologists and by the donation or loan of material from the following sources: G. F. Knowlton, Utah State Agricultural College, Logan, Utah; J. W. Leonard, Institute of Fisheries Research, Ann Arbor, Mich.; D. C. Mote and R. E. Dimick, Oregon State Agricultural College, Corvallis, Ore.; W. E. Ricker, Biological Board of

Canada, Vedder Crossing, B. C.; and H. B. Mills, Montana State College, Bozeman, Mont.

I am especially indebted to Dr. Carl O. Mohr, associate entomologist with the SURVEY, for the many drawings.

All holotypes, allotypes and part of the paratypes of the species described in this paper are deposited in the collection of the ILLINOIS NATURAL HISTORY SURVEY. Paratypes of some of the species collected in Oregon are deposited in the collection of the Oregon State Agricultural College, Corvallis.

ADDITIONS TO THE ILLINOIS PLECOPTERA¹

Acroneuria evoluta Klapalek

Acroneuria evoluta Klapalek (1909, p. 245). Original description.

Acroneuria sp. a, Frison (1935a, p. 405). Nymphal description and illustration.

Among the series of stonefly nymphs found in the White river near Rogers and Petersburg, Ind., in 1936 were the nymphs of a species of *Acroneuria* which I have listed as "sp. a" in my Illinois report (1935a) on the basis of exuviae found at Keithsburg, Ill. The rearing of males and females from these nymphs confirmed my previous opinion that this was a different species from our other Illinois stoneflies.

In 1935 I considered *evoluta* Klapalek (1909) as a synonym of *arida* Hagen (1861), based mainly upon Klapalek's drawing which certainly resembles *arida*, and failure to find two species in Illinois with female subgenital plates of so similar appearance, at least in line drawings. A study of specimens named *evoluta* in the Cornell University collection, kindly placed at my disposal by Professor P. W. Claassen, revealed that the Kansas material so named was similar to the adults reared from nymphs of my "sp. a." Although I am still doubtful whether the female type of *evoluta* Klapalek from New Orleans is the same as my material now called *evoluta*, I am using this specific name for this species on the basis of its being used by Needham & Claassen (1925) for similar specimens from Kansas. If future critical studies of the type of *evoluta* do reveal it to be the same as *arida*, and not as used here, the species here recorded will require a new name.

¹ For previous listing, see Frison (1935a, p. 311).

As just mentioned, the nymph of what I am now calling *evoluta* was described in my Illinois report (1935a) as "*Acroneuria* sp. a." Illustrations of its important structural features in the adults are now presented, fig. 64. In my key to the adults of *Acroneuria* (Frison 1935a, p. 390) the

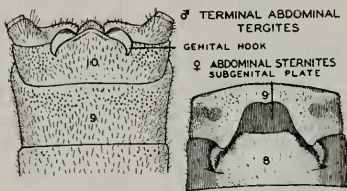


Fig. 64.—*Acroneuria evoluta*.

male and female will both run to *arida*. The subgenital plate of *arida* is wider throughout and its apical portion is not depressed or declivitous as it is in what I am now calling *evoluta*. Also, the subgenital plate of *arida* is more constricted on its lateral margins. In the males *evoluta* averages larger and the tips of the genital hooks seem to be slightly more curved inwards at their tips but to date I have been unable to find good concise characters for separating *evoluta* and *arida*. The nymphs are readily separated upon the basis of their color pattern as noted in the previous descriptions and key.

ILLINOIS.—Alton: June 26, 1934, DeLong & Ross, 1♂, 1♀. Homer park: June 30, 1927, Frison & Glasgow, 1♀, at light. Keithsburg, Mississippi river: June 14, 1931, Frison & Mohr, 2 exuv.; June 9, 1932, Ross & Mohr, 2 exuv. Oakwood, Salt Fork river: July 7, 1936, Mohr & Burks, 2♀, at light. Topeka, Quiver creek: July 9, 1936, Mohr & Burks, 1 nymph.

A series of males and females of this species was reared at Urbana from nymphs collected in the White river at Rogers, Ind., June 1936.

Acroneuria perplexa—NEW SPECIES

MALE.—General color light to dark brown. Head, fig. 65, with a yellowish brown transverse area extending between compound eyes across ocellar region, most of area anterior and posterior to this transverse patch a dark brown. Pronotum light brown, with lateral margins and raised rugosities or embossings much darker. Legs mostly light brown, with a small conspicuous black band at tip of each

femur and at base of each tibia. Antennae and cerci brown.

Head scarcely wider than pronotum; three ocelli arranged in a triangle, and lateral ocelli closer together than to median ocellus and slightly closer to each other than to inner margins of compound eyes.

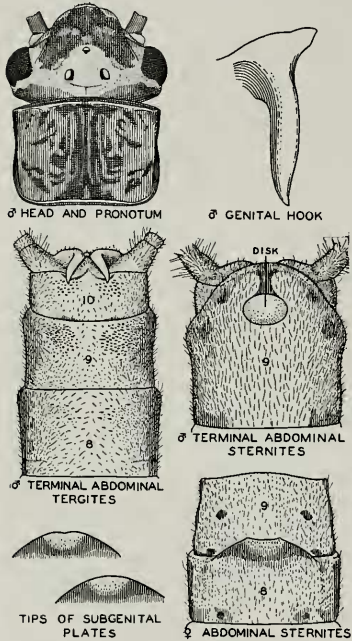


Fig. 65.—*Acroneuria perplexa*.

Pronotum, fig. 65, approximately quadrangular, much broader than long, hind angles rounded, front angles rather sharp, rugosities arranged in a definite pattern and corresponding well with color pattern as in nymph; median longitudinal depressed area narrow.

Wings long, extending well beyond tip of abdomen; membrane hyaline with veins dark brown; venation somewhat variable in regard to numbers of cross-veins but otherwise essentially typical for the genus, several cross-veins in forewing in area beyond the cord, and veins 9-11 of hind wing reaching margin of wings variable.

Abdomen, fig. 65, without special structures except for terminal segments. Tenth

tergite not cleft; genital hooks prominent, recurved upwards, narrow for most of length and tapering to a point; small spinulae numerous on ninth and tenth tergites; ninth sternite with a small, slightly transversely oval padlike disk.

Two groups of gill remnants are on the side of each thoracic segment and on upper part (usually concealed) of subanal lobes, thus correlating with gills of nymph.

Length to tip of wings 27 mm.; length to tip of abdomen 18 mm.

FEMALE.—In general very similar to the male as here described, but somewhat larger. Differs from male in important characters as follows: eighth abdominal sternite, fig. 65, with posterior margin somewhat produced over ninth sternite, in most specimens with posterior margin of subgenital plate rounded but sometimes slightly truncate or notched.

Holotype, female.—Petersburg, Ind., White river: June 16, 1936, Mohr & Burks, reared from nymph.

Allotype, male.—Petersburg, Ind., White river: June 8, 1936, Frison & Mohr, reared from nymph.

Paratypes. ILLINOIS.—Shawneetown, at light: June 21, 1927, Frison & R. Glasgow, 1♀.

INDIANA.—Rogers, White river: May 26-27, 1936, Frison, Ross & Mohr, 3♀, reared. Petersburg, White river: June 4-24, 1936, Frison, Mohr & Burks, 1♂, 4♀, reared.

OHIO.—Ironton: June 1, 1899, 1♀.

PENNSYLVANIA.—Philadelphia, at light: June 15, F. Haimbach, 1♀.

WASHINGTON, D. C.: 1♀.

The nymph of this species has not previously been recognized and therefore its description is now presented. Most of our adult material has been obtained by rearing and therefore the association of the adult with nymph and males with females rests upon a reliable foundation.

NYMPH.—General color of head, thorax and abdomen pale whitish yellow with dark markings as in illustration, fig. 66. The most important dark markings are the broad patch on head, pattern of pronotum and the band on basal half of each abdominal tergite. The light-colored W-shaped mark anterior to median ocellus and two light spots associated with each lateral ocellus on the dark part of the head are also prominent. Cerci and antennae pale whitish yellow.

Head with three ocelli arranged in a triangle, lateral ocelli much closer to each other than to median ocellus. No occipital

ridge. Labium and maxillae approximately the same as described for other members of the genus.

Pronotum about twice as wide as long, all angles well rounded. Legs, tarsal segments and cerci approximately the same as described for other species of the genus.

Two pairs of gill tufts on each thoracic segment placed as in *Acroneuria internata* (Frison 1935a, fig. 266). No submental gills. Caudal gills at apex of abdomen are present.

Approximately mature specimens with a body length, exclusive of appendages, of about 22 mm.

Nymphs and exuviae.—All from the White river, near Rogers, Portersville and Petersburg, Ind., collected from one to several weeks prior to emergence of reared adults recorded above.

This species has been described as new with full knowledge that a few specimens of the same species in other collections have been determined in the past as *pennsylvanica* (Rambur). This specific name has been applied to so many different species, however, and so much doubt exists regarding the important structural details of the type, if still in existence, that clarity and certainty in diagnostic work cannot be obtained at the present time by the use of this old name. It has seemed best, therefore, in view of the fact that my specimens of male, female and nymph are reliably associated upon the basis of reared material, to name my specimens as new. If ever the type of *pennsylvanica* Rambur is definitely proved to be the same as the species I am now naming, then my name can be shelved in synonymy. Meanwhile the present species will not have been confused with other forms going under the same name.

In my Illinois report (Frison 1935a, p. 395) a single adult female specimen of this species from Shawneetown, Ill., June 21, 1927, was erroneously recorded as *abnormis*. Due at the time to the lack of additional Illinois material and knowledge of the nymph, the observable difference in the subgenital plate was considered as an instance of unusual variation. This same specimen, too, was named by Professor P. W. Claassen in 1928 as *pennsylvanica* Rambur, indicating that part or all of his specimens recorded as *pennsylvanica* may be the species here described. Evidently, based upon its rareness in this state, Illinois

may be on the extreme limits of its range.

That some slight variation exists in the shape of the subgenital plate, fig. 65, is evident from my reared specimens. The posterior margin of this plate in most of my specimens is rounded, but in one specimen it is slightly notched, and in another somewhat truncate.

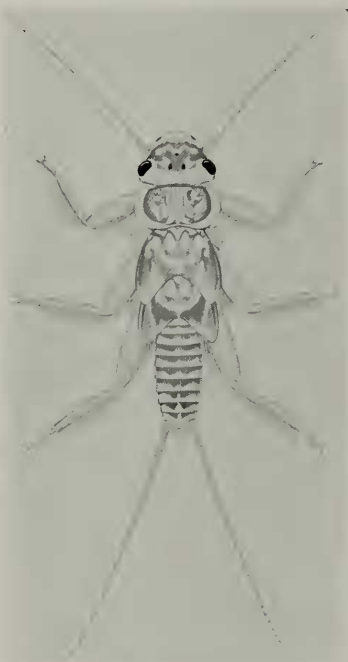


Fig. 66.—Nymph of *Acroneuria perplexa*.

My experience with the identification of *Acroneuria* to date is such as to warrant the statement that the fundamental units or species are not always easy to recognize. In Illinois there are six species as proved by important structural characters, association of reared males and females, kinds of nymphs, etc. Certainty in recognizing these species has come only through the rearing of adults from distinctive nymphs. This suggests that further revision of the genus and description of species should await the association of adults with nymphs by rearings and field work.

Togoperla kansensis (Banks)

Perla kansensis Banks (1905, p. 56). Original description.

Togoperla sp. a, Frison (1935a, p. 414). Nymphal description.

In the report on stoneflies of Illinois (Frison 1935a) a nymph was figured as "*Togoperla* sp. a" based upon several small specimens collected at Alton and Grafton, Ill., on the Mississippi river. At that time

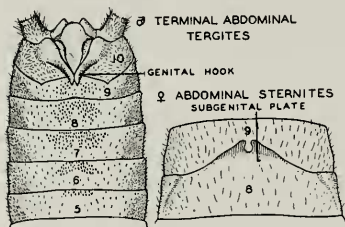


Fig. 67.—*Togoperla kansensis*.

it was stated, "It may be that this is the nymph of *Perla kansensis* Banks which is known from Kansas." Discovery of this nymph in numbers in the White river, Ind., has permitted the rearing of both sexes of the adult and the definite association of this nymph with *kansensis* Banks.

Since illustrations of the adults were not included in my 1935 report, figures of the most important structural features are presented here in fig. 67. The specific placement of this stonefly necessitates a key for separation of the adults of our two Illinois species of this genus as follows:

KEY TO SPECIES OF TOGOPERLA

Males

Eighth abdominal tergite (Frison 1935a, fig. 206) with its posterior margin produced backwards into a definite lobe; genital hooks of tenth tergite with ends rounded. *media* (Walker)

Eighth abdominal tergite, fig. 67, without a produced lobe on posterior margin; genital hooks of tenth tergite with ends pointed. *kansensis* (Banks)

Females

Subgenital plate of eighth abdominal sternite (Frison 1935a, fig. 254) but slightly produced backwards over ninth sternite. *media* (Walker)

Subgenital plate of eighth abdominal sternite, fig. 67, considerably produced backwards as a triangularly shaped projection over ninth sternite. *kansensis* (Banks)

No Illinois records for this species have been obtained in addition to those already

recorded (Frison 1935a). My Indiana records are as follows:

INDIANA.—Petersburg, White river: May 10, 1936, Frison & Mohr, 1♂, reared; June 3-4, 1936, Mohr & Burks, 12♂ nymphs, 13♀ nymphs, 6 small nymphs, 3 exuv.; June 9, 1936, Frison & Mohr, 1♀, reared; June 17-20, 1936, Frison & Mohr, 7♂, reared; June 22-27, 1936, Frison & Mohr, 3♀, reared, 4♂, reared; July 1-6, 1936, Frison & Mohr, 1♂, 3♀, reared, 2♂, reared. Portersville, East Fork river: June 3, 1936, Mohr & Burks, 3♂ nymphs. Rogers, White river: May 13, 1936, Mohr & Burks, 1 small nymph.

Hydroperla varians (Walsh)

Perla varians Walsh (1863, p. 364). Original description (♂, ♀).

Hydroperla varians Frison (1935a, p. 426). Male description and records.

In my previous treatment of the Illinois stoneflies (1935a) I did not have available for illustration the female of this species, and its nymph was unknown. In the original description of *varians* by Walsh the female was recorded but the description of it might well have applied to either of the other two Illinois species of this genus. Recently I have studied a female specimen belonging to the Academy of Natural Sciences of Philadelphia, which was named by Walsh as *varians*, and two specimens, male and female, reared from similar nymphs collected in the White river near Rogers, Ind. This reared female agrees with the female specimen now in the Philadelphia Academy, which was named by Walsh, and therefore establishes the correct association of the male and female of this species in his original description.

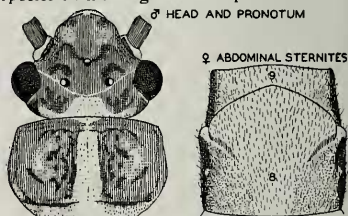


Fig. 68.—*Hydroperla varians*.

The subgenital plate and head, not illustrated in 1935, are shown in fig. 68. *Hydroperla varians* seems to be best distinguished from the females of the other Illinois species (*crobyli* and *harti*) by the subgenital plate covering a much greater area of the ninth sternite (Frison 1935a, figs. 324 and 325).

Since the nymph, fig. 69, has not been previously recognized a description of it is given as follows:

NYMPH.—General color of head, thorax and abdomen pale yellowish with brown markings. Prominent of the brown markings are the dark area between ocelli, the dark ring connecting dark area between ocelli and compound eyes, the dark border of pronotum, and pattern of meso- and metathorax. Antennae, legs and cerci pale yellowish.

Head with three ocelli forming a triangle with distance between lateral ocelli longest; lateral ocelli situated about on a line through front margin of compound eyes. No real occipital ridge but posterior margin of the dark ring connecting dark area between ocelli and compound eyes is lined with short stout spinulae. Labium and maxillae practically the same as those of *H. harti* and *H. crosbyi*.

Pronotum about twice as wide as long, all angles well rounded, fringed with short setae and stout spinulae on anterior and posterior margins; marginal groove well developed on the anterior and posterior margins and weakly so on sides. Short stout setae delineating the dark markings on meso- and metathorax.

Legs somewhat flattened, posterior margins of femora, tibiae and tarsi with a fringe of long fine setae.

Abdomen with short stout spinulae very prominently lining posterior borders of tergites and also with scattered spinulae on tergites in addition to short hairs. Cerci long, many segmented, segments progressively longer apically, a longitudinal row of long fine hairs in middle of segments from base to apex.

Submentum with a small fingerlike gill at each outer posterior corner.

Body length, exclusive of appendages, 15 mm.

INDIANA.—Rogers, White river: April 21, 1936, Frison & Mohr, 1 nymph. Portersville, East fork White river: June 3, 1936, Mohr & Burks, exuv. Petersburg, White river: June 3, 1936, Mohr & Burks, exuv. Rogers, White river: April 21 and 30, 1936, Frison & Mohr, exuv.

A revised key for the Illinois nymphs of this genus is as follows:

KEY TO NYMPHS OF HYDROPERLA

1. Dorsal segments of abdomen with basal portions dark and apical portions light

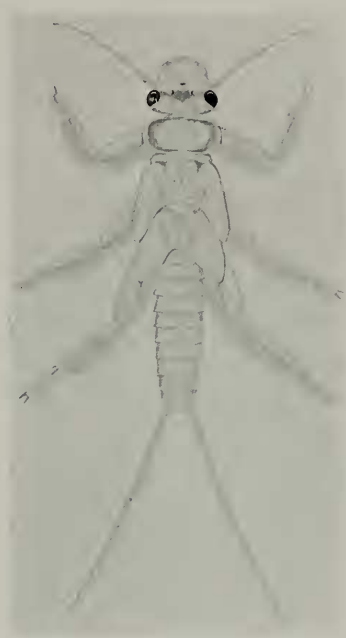


Fig. 69.—Nymph of *Hydroperla varians*.

- so that abdomen appears distinctly transversely banded (Frison 1935a, fig. 329)..... **crosbyi** (N. & C.)
 Dorsal segments of abdomen not thus distinctly banded..... 2
2. Dorsum of head with a round open eyelike spot ringed with brown back of epicranial arm between compound eye and lateral ocellus on each side of head; abdominal tergites without brown spots except those associated with stout spinulae..... **variens** (Walsh)
 Dorsum of head with a wide dark transverse band crossing head anterior to lateral ocelli, no open eyelike spots; abdominal tergites with some small dark spots in addition to those associated with stout spinulae..... **harti** Frison

ADDITIONS TO NEARCTIC PLECOPTERA NOT KNOWN IN ILLINOIS

Nemoura oregonensis Claassen

Nemoura oregonensis Claassen (1923, p. 288). Original description.

This species was originally described from a single male collected "June 21, 1922, Blitzen Valley, Harney county,

Oregon," and has not been recorded since. A series of specimens of this species, including the previously undescribed female, have been recognized among an assortment of material sent to me for determination by entomologists of the Oregon Agricultural College.

FEMALE.—Similar in most morphological features to the male. Wings, fig. 70, with the same pattern as for the male. Seventh abdominal sternite, fig. 70, with posterior

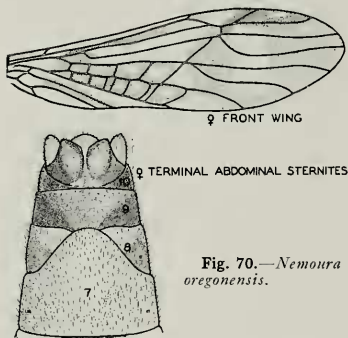


Fig. 70.—*Nemoura oregonensis*.

margin produced bulblike, over eighth sternite. Four fingerlike gill remnants in ventral cervical region.

Allotype, female.—Corvallis, Ore., Oak creek: Apr. 13, 1934, E. E. Ball.

OREGON.—Corvallis: Apr. 10, 1933, R. E. Dimick, 1♀; Apr. 16, 1931, 1♂; Dixon creek, March 10, 1935, R. E. Dimick, 1♂; Oak creek, March 18, 1934, R. W. Prentiss, 1♀, and March 31, 1934, E. E. Ball, 1♂, and Apr. 7, 1934, E. E. Ball, 1♀. Benton county, Woods creek: Apr. 11, 1936, R. E. Rieder, ♂♂, ♀♀.

Nemoura tuberculata—NEW SPECIES

MALE.—Body and appendages essentially brown with paler intersegmental areas and patches on body; particularly noticeable because of lighter color is the area on head between compound eyes and posterior to ocelli, a tendency for a light median stripe extending longitudinally across dorsal parts of thorax and abdomen, most of legs and venter of body. Length to tip of wings 10 mm.; length of body 6.5 mm.

Head much wider than pronotum. The pronotum broader than long, angles rounded, and with width of anterior margin greater than that of posterior margin. Lateral ocelli slightly closer to compound eyes than to one another, located on a line

with middle of compound eyes, median ocellus located somewhat anterior to a line between front margin of compound eyes. Wings, fig. 71, stained with brown except for clear spots in scattered areas; subcosta ending before cord. Ventral cervical region without gill remnants.

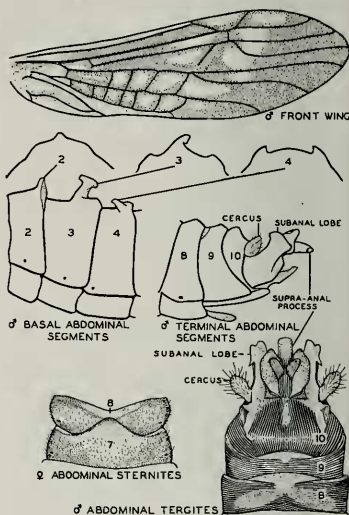


Fig. 71.—*Nemoura tuberculata*.

Abdomen with tergites 2, 3 and 4, fig. 71, with prominent tubercles; tubercle on second tergite small, conical and on median line; one tubercle on third tergite large and bent over at tip, flanked by a smaller hump on each side, the whole with a somewhat asymmetrical arrangement; fourth tergite with two small humps, one each side of median line. Abdominal tergites 5 through 9 without special structures. Tenth tergite modified into two flat plates sloping downwards towards base of supra-anal process. Cerci one-segmented, bulbous and without special structures. Supra-anal process a bluntly tipped pronglike structure bent upwards and backwards between an encasing sheath composed of subanal lobes and two lobes originating each side of base of supra-anal process. Sub-anal lobes well developed, extending backwards and upwards to form a kind of protecting sheath for supra-anal process and flanking lobes.

Ninth abdominal sternite with a well-sclerotized subgenital plate which extends posteriorly somewhat over lower base of subanal lobes and is almost truncate on posterior margin, arising beneath the tip of this plate and extending upwards between subanal lobes to supra-anal process is a fingerlike tongue or projection; a small lobe, slightly longer than broad, at base of subgenital plate.

FEMALE.—Similar in most morphological features to the male. Seventh abdominal sternite, fig. 71, with a poorly developed subgenital plate, partly overlapping base of eighth sternite and rounded.

Holotype, male.—Rock creek near Philomath, Ore.: March 28, 1935, F. Foley.

Allotype, female.—Hillsboro, Ore.: March 19, 1936, Gray & Schuh.

Paratypes. OREGON.—Same data as for allotype, 3♂. Corvallis, Dixon creek: March 10, 1935, R. E. Dimick, 2♂.

This species is easily recognized from all other described *Nemoura* known to me by descriptions or specimens because of the extraordinary humps or tubercles on the basal abdominal tergites.

Leuctra forcipata—NEW SPECIES

MALE.—Body and appendages brown. Wings with membrane uniformly light brown, veins but slightly darker, venation practically typical for genus in that there is no cross-vein beyond the tip of subcosta and radial sector originated from the radius apart from media. Second tarsal segment much shorter than either first or third. Length to tip of wings 8 mm.; length of body 6 mm. No gill remnants evident.

Head much wider than pronotum, lateral ocelli about twice as far apart as from inner margin of compound eyes; median ocellus about as far forward from lateral ocelli as distance between the latter; maxillary palpi large.

Pronotum much longer than wide, with a slightly impressed median longitudinal area or stripe which is about one-fifth as wide as pronotum, and some dark embossed markings flanking this stripe.

Abdomen with the first nine segments normal, darkly sclerotized and essentially similar, except that eighth tergite has its middle basal portion more membranous, with result that crescent-shaped anterior margin of ninth tergite is plainly visible. Tenth tergite, fig. 72, partly cleft, supra-anal process small, somewhat fingerlike and

concealed by other structures; subanal lobes modified into a long produced lobe, curving upward beneath cerci; cerci sclerotized, pincher shaped, main upper prong with small tooth at base and tip strongly pointed, main lower prong similarly shaped, tips of two main prongs widely divergent, base of cerci from which prongs project narrow; ninth sternite produced into a short, feebly indented plate.

FEMALE.—Similar in most morphological features to the male. Terminal and ab-

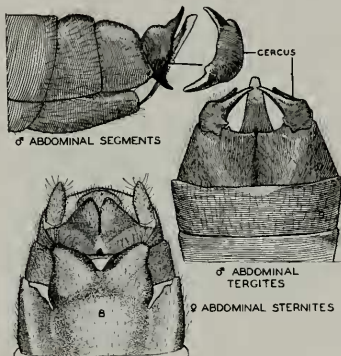


Fig. 72.—*Leuctra forcipata*.

dominal sternites with a well-developed subgenital plate, the lobes of which are widely divergent. Dorsal tergites of abdomen 1 through 3 darkly sclerotized, through 8 mostly membranous with a median longitudinal darkly sclerotized stripe, ninth and tenth tergites darkly sclerotized.

Holotype, male.—Corvallis, Ore.

Allotype, female.—Same locality as holotype.

Paratypes. OREGON.—Same locality as holotype, 3♂, 1♀. Alsea Mt.: March 18, 1936, J. Schuh, 1♂.

This species is closely related to *L. occidentalis* Banks and to *L. purcellana* Neave. It differs from both in the shape of the cerci. In *purcellana* the cerci have the upper projection or prong truncate and in *occidentalis* the upper prong is much longer than the lower and its base is more elongate.

Eucapnopsis brevicauda (Claassen)

Capnia brevicauda Claassen (1924b, p. 55). Original description.

Eucapnopsis brevicauda Neave (1934, p. 5).

This species has had a short but interest-

ing history to date. The original description was based upon females, the male being unknown at the time, and placed in the genus *Capnia*. Needham & Claassen (1925) recognized the short cerci as aberrant for *Capnia* and noted the assignment of *brevicauda* to *Eucapnopsis* Okamoto (1922); the latter, however, they considered a sub-genus.

Since then Neave (1934) has found this species in British Columbia and has de-

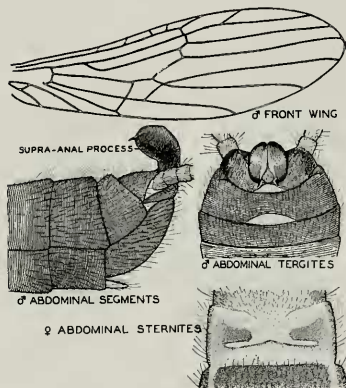


Fig. 73.—*Eucapnopsis brevicuda*.

scribed the previously unknown male. It has a combination of characters which caused him to consider *Eucapnopsis* as a valid genus and with this conclusion the writer is in agreement (1935a).

Illustrations, records and notes pertaining to this species are given here because of its peculiar combination of morphological characters, the likelihood of its being overlooked and redescribed as new because it is not keyed to genus in any present key of North American forms, and the scarcity of information regarding its geographical range. The small elongate lobe on the ninth sternite of the male, fig. 73, is an outstanding character for its separation from *Capnia*. The presence of a cross-vein beyond the tip of the subcosta, which in this instance has real significance, is sufficient to separate it from *Leuctra*. The short cerci, not exceeding six segments in any of the specimens recorded here, contrasts with the one, modified or unmodified, found in *Leuctra*, and the many in *Capnia*. I still

consider my assignment of *Eucapnopsis* to the Leuctridae (1935) as the present best family placement for this genus.

New records are as follows:

OREGON.—Corvallis, Oak creek: March 31, 1934, E. E. Ball, 3♂, 6♀; Apr. 1, 1934, R. Dimick, 1♂, 2♀; Apr. 13, 1934, E. E. Ball, 1♀. Philomath, Rock creek: March 19, 1933, R. Dimick, 6♂, 10♀; March 28, 1935, 1♂, 2♀; Greasy creek, Apr. 1, 1936, V. E. Starr, 1♂. King's Valley, tributary of Luckimute river: May 11, 1933, Prentiss & Dimick, 1♀.

Capnia distincta—NEW SPECIES

MALE.—Body and appendages brown to black. Wings abbreviated and extending only to base of abdomen. Cerci long, many segmented. Length of body 6.5 mm. No gill remnants visible.

Head much wider than pronotum; lateral ocelli about three times as far apart as from inner margins of compound eyes; median ocellus about as far forward from lateral ocelli as distance between them; maxillary palpi less than thickness of basal flagellar segments.

Pronotum slightly wider than long, with a distinct median line, with indistinct embossings.

Abdomen with the first four segments normal or without special structures; beginning with fifth tergite and extending to ninth with a transverse swollen ridge or hump on each tergite, except that membranous cleft of tenth tergite carries forward on middle area of ninth and eighth tergites. Supra-anal process, fig. 74, very

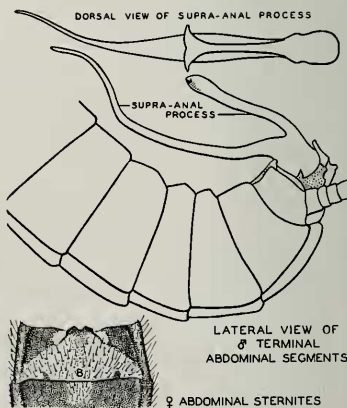


Fig. 74.—*Capnia distincta*.

long, extending about to third segment, divided into two pronglike processes, the upper shorter than the lower and with tip slightly fan shaped, lower prong curving to right of body and tapering to a point. Subanal lobes or plates heavily sclerotized, extending up between bases of cerci as two fused plates with outer upper corners slightly hooked and middle prolonged towards supra-anal process as a fingerlike projection. Ninth sternite without a lobe at base, posterior margin prolonged and slightly recurved upwards to meet subanal lobes.

FEMALE.—Similar in most morphological features to the male. Eighth abdominal sternite, fig. 74, forming a subgenital plate, tip darkly sclerotized, basal portion pale or lightly sclerotized, triangular areas in lateral posterior corners of sternite darkly sclerotized, tip of plate distinctly indented. A broad membranous median stripe extends longitudinally across tergites 1 through 7 and slightly onto the basal part of the eighth.

Holotype, male.—Hayden Valley, Yellowstone National park, Wyo.: April 4, 1935, H. B. Mills.

Allotype, female.—Same data as for holotype.

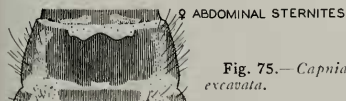
Paratypes.—Same data as for holotype, 39.

This is a very distinctive species. It runs in the key to species of the genus *Capnia* in Needham & Claassen (1925) to the couplet including the species *manitoba* Clsn. and *columbiana* Clsn. It differs markedly from both in the shape of the supra-anal process. Its relationship with *columbiana* is further indicated in the female by character of the subgenital plate but here too it differs markedly.

Capnia excavata Claassen

Capnia excavata Claassen (1924a, p. 47). Original description.

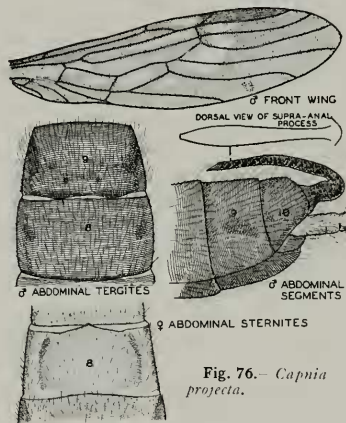
Among a series of specimens of *Capnia* sent to me from Oregon I have recognized this species, originally described by Claassen on the basis of males from California. In addition to extending the known range for this species, this lot of material has revealed what I consider to be the female, hitherto undescribed.



FEMALE.—Similar in most morphological features to the male. Eighth abdominal sternite, fig. 75, with posterior edge slightly projecting backwards in middle portion and evenly sclerotized, a transverse membranous band separating seventh and eighth sternites. A broad membranous median stripe extends longitudinally across tergites 1 up to 9.

Allotype, female.—Alsea Mt., Ore.: March 16, 1936, K. Gray.

OREGON.—Alsea Mt.: March 16, K. Gray, 1♂, 5♀; March 18, 1936, J. Schuh, 1♀. Corvallis, Oak creek: Jan. 24, 1934, J. Roaf, 3♂, 2♀.



Capnia projecta—NEW SPECIES

MALE.—Body and appendages brown. Wings, fig. 76, with membrane mostly light brown, except that portions of cells in middle area of wing are more hyaline, forming spots; veins dark brown; venation in essentials typical for genus. Length to tip of wings 7 mm.; length of body 4.5 mm. No gill remnants evident.

Head much wider than pronotum; lateral ocelli about three times as far apart as from inner margin of compound eyes; median ocellus about as far from lateral ocelli as distance between them; maxillary palpi less than thickness of basal flagellar segments.

Pronotum scarcely longer than wide, with a feebly impressed median longitudinal area or stripe which is about one-sixth as wide as pronotum, some indistinct embossings flanking impressed stripe.

Abdomen with the first nine segments normal or without special structures except that median area of first few basal tergites is less sclerotized. Tenth tergite cleft; supra-anal process, fig. 76, recurved back over tergites 9 and 10, slightly enlarged before pointed tip, extending to posterior margin of eighth tergite; eighth and ninth tergites without any special structures or tubercles; in a few specimens median area of ninth tergite is somewhat membranous. Subanal lobes or plates small, somewhat transverse, with median posterior margin produced slightly upward. Ninth sternite without a ventral lobe at base, posterior margin produced and rounded behind. Cerci many segmented.

FEMALE.—Similar in most morphological features to the male. Eighth abdominal sternite, fig. 76, with posterior margin in middle produced into a small point; seventh and eighth sternites otherwise unmodified and separated by membranous area. A broad membranous median stripe extends longitudinally across tergites 1 up to 9.

Holotype, male.—Corvallis, Ore., Oak creek: Jan. 24, 1934, J. Roaf.

Allotype, female.—Same data as for holotype.

Paratypes. OREGON.—Same data as for holotype, 1♂, 2♀. Corvallis: Dec. 23, 1933, A. W. Larson, 1♂, 14♀; March 2, 1937, R. E. Rieder, 1♂; roof of agriculture bldg., Jan. 22, 1934, J. Roaf, 2♂; Feb. 4, 1935, R. W. Prentiss, 1♀; Dixon creek, Jan. 19, 1935, R. W. Prentiss, 3♂, 3♀, and Jan. 23, 1935, R. W. Prentiss, 2♀; Oak creek, Jan. 21, 1936, R. W. Prentiss, 1♀, and Jan. 30, 1935, R. W. Prentiss, 2♀. Alsea, Alsea river: Jan. 5, 1935, R. Dimick, 1♂. Lincoln county, north fork Alsea river: May 2, 1936, R. E. Rieder, 1♀. Philomath, Rock creek: Dec. 2, 1934, R. Dimick, 1♂, 3♀. Benton county, Woods creek: Apr. 11, 1936, R. E. Rieder, 1♀.

In the key to males of the genus *Capnia* by Needham & Claassen (1925) this species will run closest to *gracilaria* Clsn. It differs from the latter in having a much shorter supra-anal process, *gracilaria* having a supra-anal process which reaches to the seventh tergite, whereas in *projecta* the supra-anal process extends only to the posterior margin of the eighth tergite. *Capnia oenone* Neave (1929) is another very closely related species and possibly future studies will show that they are identical, in which case *oenone* will have priority. According to the drawing of Neave the female of *oenone* has a subgenital plate which is not produced, whereas in

the females of *projecta* there is an evident medial projection of the posterior margin, fig. 76, of the eighth abdominal sternite. Both sexes of *projecta* have wings with clear spots in the cells adjacent to the cord, which are not mentioned in the original description or evident in paratypes of *oenone* sent to me by Neave.

Capnia promota—NEW SPECIES

MALE.—Body and appendages brown. Wings in general with membrane rather uniformly light brown, in some specimens darker near veins, area in proximal position

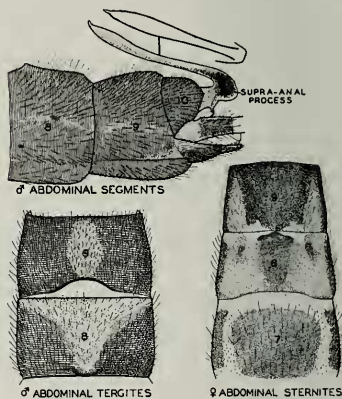


FIG. 77.—*Capnia promota*.

of area beyond costa darkened and usually contrasting with rest of wing membrane; venation in essentials typical for genus, radius where joined by the radial sector somewhat bowed or humped. Length to tips of wings 7-8 mm; length of body 4-5 mm. No gill remnants evident.

Head much wider than pronotum; lateral ocelli about three times as far apart as from inner margin of compound eyes; median ocellus about as far forward from lateral ocelli as distance between them; maxillary palpi less than thickness of basal flagellar segments.

Pronotum slightly wider than long, with a feebly impressed median longitudinal area or stripe which is about one-sixth as wide as pronotum, some indistinct embossings flanking impressed stripe.

Abdomen with the first six segments normal or without special structure; seventh tergite with a somewhat V-shaped

membranous area on posterior margin; eighth, ninth and tenth tergites, fig. 77, with median longitudinal membranous area for reception of supra-anal process, this area on eighth tergite more V-shaped and terminating on anterior margin in a small raised ridge. Supra-anal process elongate, slightly enlarged before pointed tip, recurved back over tergites 8, 9 and 10 and extending about to anterior margin of the eighth. Subanal lobes or plates small, somewhat transverse, with median posterior margin slightly produced upwards. Ninth sternite without a ventral lobe at base, posterior margin produced and rounded behind. Cerci with many segments.

FEMALE.—Similar in most morphological features to the male. Eighth abdominal sternite, fig. 77, with middle portion of posterior margin produced into a short projection with its middle part slightly pointed; seventh and eighth sternites separated by a membranous area. A broad membranous median stripe extends longitudinally across tergites 1 up to 9.

Holotype, male.—Corvallis, Ore., roof of agriculture bldg.: Jan. 23, 1934, K. Gray & D. Edwards.

Allotype, female.—Same data as for holotype.

Paratypes. OREGON.—Same data as for holotype, 16♂, 4♀. Same place: Jan. 22, 1934, J. Roaf, 4♀; Jan. 26, 1935, R. Prentiss, 1♂, 1♀; Jan. 30, 1934, 18♂, 10♀, 2 mating pairs. Corvallis, Oak creek: Jan. 1, 1936, 3♂, 6♀; Jan. 15, 1934, Roaf, 1♂, 1♀; Jan. 16, 1935, R. Dimick, 1♀, and R. W. Prentiss, 1♀; Jan. 24, 1934, Roaf, 1♀; Jan. 24, 1935, R. W. Prentiss, 1♂, 4♀; Jan. 30, 1935, R. W. Prentiss, 3♂, 4♀; March 29, 1935, S. Jewett, Jr., 1♀; Apr. 2, 1935, J. Schuh, 1♀. Corvallis: Jan. 23, 1935, R. W. Prentiss, 1♀; Jan. 27, 1933, J. Roaf, 1♀; Jan. 31, 1934, N. P. Larson, 1♂; Feb. 27, 1933, R. Dimick, 1♀; March 15, 1935, J. Schuh, 1♀. Philomath, Rock creek: March 19, 1933, R. Dimick, 15♀. Wrens, Mary's river: March 16, 1935, R. Dimick, 1♂, 2♀; March 19, 1933, R. Dimick, 3♀. King's Valley, tributary of Luckinute river: May 11, 1933, Prentiss & Dimick, 1♀. Woodburn: Jan. 31, 1935, 1♂. Stayton, Stayton creek: March 20, 1934, R. Dimick, 1♀. Hillsboro: March 19, 1936, Schuh & Gray, 2♂, 3♀.

This species is very closely related to *C. gracilaria* Clsn., described from Manitoba, and to *C. oenone* Neave, described from Alberta. It is not improbable that large series of specimens from many localities would reveal that the differences at present noted between them break down. The only safe procedure at this time is the recognition of this Oregon material as representing a

new species. In the original description of *C. gracilaria* it is stated that the supra-anal process extends to the seventh tergite and that there is a slight indication of a small median knob on this tergite. This Oregon material does not have a knob on the seventh tergite but there is a small raised ridge on the anterior margin of the eighth tergite. It differs, too, from the illustration of the supra-anal process of *gracilaria* as given by Needham & Claassen (1925) in having the tip more abruptly pointed and in being slightly enlarged before its end. *C. oenone* Neave differs in the description of the male by the lack of reference to a raised ridge on anterior margin of the eighth tergite and in the female by the eighth sternite, which is stated to be "not produced." Two paratypic specimens of *oenone* kindly given to me by Neave do not have the ridge on the anterior margin of the eighth tergite visible. It should be noted, too, that the supra-anal process of these paratypes extends only to the posterior margin of the eighth segment, a condition shown in Neave's drawing but contrary to his statement in the original description that this process extends "forward to the posterior margin of the seventh abdominal tergite." If the type and other males of the paratypic series have a supra-anal process extending to the posterior margin of the seventh tergite, this would be another point of difference between *oenone* and *promota*.

Dictyopterygella knowltoni—NEW SPECIES

MALE.—General color yellowish brown to dark brown. Head, fig. 78, mostly dark brown with some lighter areas, the spot between ocelli and extending back to pronotum particularly conspicuous. Pronotum, fig. 78, chiefly dark brown with a medial longitudinal stripe and dark embossed markings; meso- and metathorax mostly black or brownish. Abdomen apparently mostly brown, with basal tergites and sternites somewhat lighter. Legs yellowish to dark brown. Antennae and cerci light brown.

Head wider through compound eyes than width of pronotum; three ocelli forming a nearly equilateral triangle, distance between lateral ocelli greatest, lateral ocelli placed on a line slightly back of front margin of compound eyes, somewhat farther

removed from one another than from compound eyes.

Pronotum approximately quadrangular, much broader than long, diameter at front angles apparently greater than at hind angles, front margin bowed, front angles appear sharp, a distinct pattern of raised rugosities on surface each side of median stripe.

Legs with first tarsal segment much longer than second and third together, the second much shorter than third.

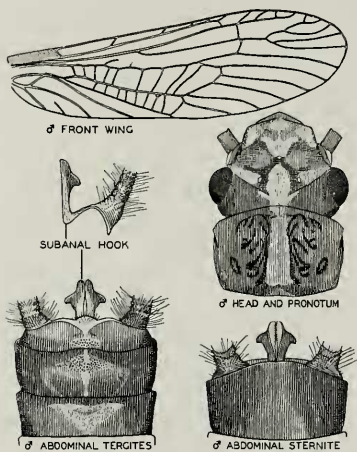


Fig. 78.—*Dictyopterygella knowltoni*.

Wings, fig. 78, with venation as in illustration, tip of wing with branches of radial sector somewhat turned upwards. Wing membrane stained with brown and veins dark brown. Hind wing with eight branches of anal veins reaching margin of wing.

Abdomen, fig. 78, with tergites normal except for small areas on terminal segments which are heavily covered with spinulae; tenth tergite not cleft for reception of the supra-anal process. Ninth sternite not produced and recurved upwards, without a disklike pad. Subanal hook very peculiar, prolonged backwards as a projection from body, the two plates together when viewed from above or below forming a mushroom-shaped structure.

Length to tip of wings, 15 mm.; length to tip of abdomen, 12 mm. No gill remnants found on any body area.

Holotype, male.—Logan, Utah: June 23, 1929, G. F. Knowlton.

This new species is unique among North American stoneflies described to date by virtue of the peculiarly prolonged subanal plates, fig. 78. Tentatively, pending the collection of fresh material and the female, it is placed in the genus *Dictyopterygella* Klapalek (1904). This genus is characterized among other things by the peculiar subanal plate which in such a European species as *D. nansenii* Kempny is very suggestive of *knowltoni* as here described.

Dictyopterygella is placed by Klapalek in the Perlodidae. According to the author's studies the Perlodidae of North America (*Perlodes*, *Isogenus* and *Hydroperla*) all have peculiar fingerlike gills on the submentum of the nymphs and remnants of such gills in the adults. I cannot find such remnant submental gills on the submentum of *knowltoni* but it must be said that the type was originally a pinned specimen and it is possible that either such gills cannot now be located in the relaxed specimen, have been accidentally lost through handling or never were present. My judgment is that they never existed and accordingly I am skeptical regarding the placement of this new species in Perlodidae. As far as I am aware the species previously assigned to *Dictyopterygella* are rarities, have never been studied with reference to the presence of remnant submental gills or have never been associated with their nymphs. It will not be surprising, therefore, if *knowltoni* and the genus to which it belongs will eventually be placed in the group of genera now going by the family name of Perlidae in North American literature. The type of wing venation is not sufficient to place the genus as to family.

I take pleasure in naming this species for its collector, Dr. G. F. Knowlton, who has sent to me for study many specimens of Plecoptera from Utah.

Hydroperla parallela Frison

Hydroperla parallela Frison (1936, p. 261). Original description.

The original description of this species was based upon a single male (Frison 1936). Since then additional specimens of the male have been received, and also the undescribed female, a brief description of which is here presented.

FEMALE.—Similar in most morphological respects to the male (Frison 1936). Color

pattern of dorsum of head and pronotum as in fig. 79. Subgenital plate, fig. 79, well developed but only slightly extending over ninth sternite, posterior margin essentially straight with corners angulate.

Allotype, female.—Cultus lake, B. C., Sweltzer creek: Apr. 28, 1935, W. E. Ricker.

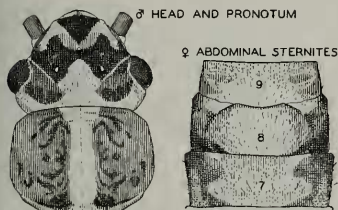


Fig. 79.—*Hydroperla parallela*.

Other records for this species which have accumulated since it was originally described are as follows:

BRITISH COLUMBIA.—Cultus lake: Apr. 18, 1936, W. E. Ricker, 1♀; Apr. 21, 1936, W. E. Ricker, 1♂.

OREGON.—Clatskanie, Beaver creek: May 9, 1936, J. Schuh, 1♂. Hillsboro: March 19, 1936, Gray & Schuh, 1♂.

Chloroperla orpha—NEW SPECIES

MALE.—Dominant color a pale greenish white in life and pale yellowish white when preserved. Dark or black areas are as follows: ocelli and compound eyes, fig. 80, lateral margins of pronotum, and a narrow longitudinal stripe extending across abdominal tergites as in fig. 80. Cerci and antennae at base concolorous with body, segments of antennae beginning a short distance from base progressively becoming darker to black. Wings with membrane and veins pale.

Head wider through compound eyes than width of pronotum; three ocelli forming a nearly equilateral triangle, lateral ocelli placed about on a line with posterior margin of compound eyes, about twice as far apart as each lateral ocellus is distant from compound eye. Antennae many segmented, basal segments not much longer than broad, middle and apical segments about of equal length and much longer than broad.

Pronotum slightly broader than long angles rounded, pronotal flange not well developed, embossings not evident.

Legs slender; first and second tarsal segments very short, third tarsal segment over

twice as long as length of first and second together.

Wings extending well beyond tip of abdomen; with membrane and veins pale; no anal lobe on hind wing and in this important respect, as well as venation in general, agreeing with *Chloroperla* as now recognized for North America.

Dorsal segments of abdomen without special structures. Tenth tergite somewhat cleft for reception of a small tablike supra-anal process. Subanal lobes not specialized. Ninth sternite produced and turned upward over tenth segment so that it is not visible from below, without a padlike disk near middle of apical portion.

Length to tip of wings 7 mm.; length to tip of abdomen 5.5 mm. No gill remnants on any body area.

FEMALE.—Not known.

Holotype, male.—Namakagon river, Spooner, Wis.: June 5, 1936, Frison & Ross.

Paratypes.—Same data as for holotype, 11♂.

This species is of special interest because the genus was considered by Needham & Claassen (1925) to contain but a single North American species and all my material, previous to the collecting of these specimens, has supported this view. The lack of an anal lobe on the hind wing separates this small delicate species from other

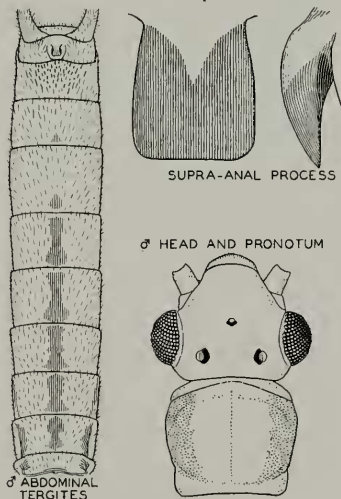


Fig. 80.—*Chloroperla orpha*.

superficially similar forms belonging in the genera now going in North America under the generic names of *Alloperla* and *Iso-perla*. The dark stripe on the abdominal tergites and the dark lateral margins of pronotum are sufficient to separate this species from the only other North American species now placed in *Chloroperla*, namely *cydippe*.

Kimmins (1936) has recently shown that the generic name *Chloroperla* Newman has as its type the European species *tripunctata* (Scopoli) and that *Isopteryx* is synonymous with *Chloroperla*, as originally pointed out by Banks (1906). It is questionable whether the species now going in North America under the name *cydippe* Newman (probably an *Alloperla* according to a recent letter from W. E. Ricker who has seen the types) has been correctly identified. There also is a point to be settled regarding placing the species now called *cydippe* in North America (Needham & Claassen 1925) in *Chloroperla*. When some of these points are finally cleared it is likely that the species here described will be placed in another genus together with the species to date called *cydippe*. *Brevis* Banks (1895) is the specific name which must replace *cydippe* if the latter is an *Alloperla*.

Hastoperla was originally proposed by Ricker (1935a) as a new genus for the reception of his new species *calcareo*. This latter species, however, is an outright synonym of *cydippe* as recognized by Needham & Claassen (1925). If *Chloroperla* of Europe proves not to be the same as *Chloroperla* of American authors then the name *Hastoperla* may by accident be available to serve for the American species placed to date in *Chloroperla*. The species *Chloroperla idei* Ricker and *C. milnei* Ricker (1935a) do not belong in *Chloroperla*, as used to date in America, but in *Alloperla*.

Isoperla pinta—NEW SPECIES

MALE.—General color black or brown with conspicuous yellow spots or areas, particularly on head and thorax. Head, fig. 81, black with yellow areas as follows: small spot in ocellar space and anterior to median ocellus, large area between compound eyes and lateral ocelli, and spots on anterior margin beyond articulation of antennae. Pronotum chiefly black or brownish with a median longitudinal yellow

stripe, interrupted in middle with line of black, and other spots on disk and lateral margins as indicated in fig. 81; meso- and metathorax mostly black or brownish. Abdomen mostly black or brownish, except for yellowish median longitudinal stripe on

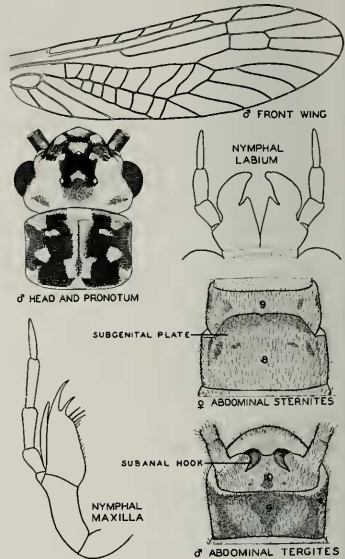


Fig. 81.—*Isoperla pinta*.

sternites and partially yellowish ninth and tenth tergites. Legs brownish with basal two-thirds of femora mostly yellowish. Antennae brown. Cerci yellowish brown, each segment with basal portion lighter than apical part.

Head much wider through compound eyes than width of pronotum; three ocelli forming a nearly equilateral triangle, lateral ocelli placed about on a line with middle of compound eyes, about as far removed from one another as from compound eyes. Antennae many segmented; basal segments wider than long, middle and apical segments progressively becoming longer than wide.

Pronotum approximately quadrangular, much broader than long, angles rather sharp; pronotal flange well developed on anterior and posterior margins but weakly developed on sides; an indistinct pattern of

raised rugosities on surface; and with a faint longitudinal median depressed stripe somewhat less in width than distance between lateral ocelli.

Legs with first tarsal segment slightly longer than second, third segment about twice as long as first.

Wings long, extending well beyond tip of abdomen; membrane but slightly tinged with brown, veins dark brown and contrasting; venation slightly variable in right or left wings or between individuals but essentially typical for the genus as now recognized in North America.

Abdomen with dorsal segments without special structures. Tenth tergite not cleft; subanal lobes modified into a pair of up-turned or recurved pointed hooks which are about as wide at base as diameter of basal segments of cerci. Ninth sternite strongly produced and turned upward around tenth segment so that it is not visible from below, without a distinct padlike disk near middle of apical portion. Eighth sternite with a small lobe, wider than long, in middle of posterior margin.

Length to tip of wings 14 mm.; length to tip of abdomen 10.5 mm. No gill remnants on any body area.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male. Slightly larger than male, and differs as follows: eighth abdominal sternite, fig. 81, with posterior margin or subgenital plate produced about one-third over ninth sternite, posterior margin rounded and in some specimens slightly indented at middle.

Holotype, male.—Curry county, Ore., Floras creek: May 20, 1933, R. Dimick.

Allotype, female.—Corvallis, Ore.: April 5, 1933, N. F. Larson.

Paratypes. BRITISH COLUMBIA.—Cultus lake: June 5, 1927, H. H. Ross, 1♀. W. E. Ricker has supplied the following material of his collection from Cultus lake, for inclusion in the paratypic series. Apr. 1932, 1♂, 1♀; Apr. 22, 1932, 1♂, 2♀; Apr. 24, 1935, 5♂, 11♀; Apr. 26, 1935, 4♂, 3♀; Apr. 28, 1935, 4♂, 10♀; May 13, 1935, 1♂, 1♀; May 18, 1933, 1♂; May 18, 1935, 1♂, 1♀; May 20, 1935, 2♀; May 26, 1932, 1♂; May 28, 1935, 1♂, 4♀; June 3, 1935, 1♀; June 7, 1934, 1♀.

OREGON.—Philomath, Woods creek: Apr. 24, 1936, W. Graf, 1♂. Beatty, Swan river: June 17, 1934, J. Schuh, 3♀. Winchester, North Umpqua river: March 22, 1933, R. Prentiss, 1♀. Alesa, Alesa river: May 22, 1933, R. Dimick, 1♀.

Mr. Ricker has also supplied me with four cast nymphal skins, among other

nymphs, collected at Cultus lake, British Columbia, April 24, 1935, and May 28, 1935, which I am certain belong with this species. Besides belonging to *Isoperla* (l. s.) these nymphal skins have a color



Fig. 82.—Nymph of *Isoperla pinta*.

pattern on the head and thorax which is practically identical with that of the adults and therefore the basis of my association.

NYPH.—General color of head, thorax and abdomen pale yellow with dark markings as in fig. 82. Markings on dorsum of pronotum are very suggestive of pattern shown by adult. Antennae yellowish with a dark spot on large basal segment. Cerci with tips of segments narrowly ringed with black or brown.

Head with three ocelli forming a nearly equilateral triangle, lateral and median ocelli occupying the same relative position as in adult. No occipital ridge. Labium and maxillae as in fig. 82.

Pronotum about twice as wide as long, all angles well rounded; fringed with numerous small setae and occasional long ones, marginal groove well developed on anterior and posterior margins but absent on lateral margins. Mesonotum with wing pads extending almost straight backwards, those on metanotum extending slightly outward.

Legs very little flattened; hind margins of femora, tibiae and tarsi with a fringe of long fine setae; femora with a narrow dark band before apex.

Cerci long, many segmented, segments progressively longer apically, distal half with a row of long fine setae on dorsal surface in addition to shorter ones encircling segments.

Approximately mature specimens with a body length, exclusive of appendages, of about 15 mm. Submental, thoracic and abdominal gills entirely lacking.

Nymphs. BRITISH COLUMBIA.—Cultus lake, Sweltzer creek: March 28, 1937, W. E. Ricker; April 24, 1935, cast skins; Reservoir creek, May 30, 1935, W. E. Ricker, cast skins.

Isoperla truncata—NEW SPECIES

MALE.—Dominant color a pale whitish yellow with some light brown and dark markings. Head, fig. 83, mostly pale whitish yellow; compound eyes and area im-

mediately surrounding ocelli black; lateral ocelli connected with median ocellus by short dark brown stripes which connect with a large solid transverse quadrate brown patch adjacent to median ocellus. Prothorax mostly pale whitish yellow with two longitudinal brown stripes, particularly accentuated in depth of brown at anterior margin; dorsum of meso- and metathorax mostly pale brown. Abdomen pale with weakly indicated brownish median and lateral longitudinal stripes on dorsum. Antennae, cerci and most of legs pale brown.

Head much wider through compound eyes than pronotum; three ocelli forming a nearly equilateral triangle, lateral ocelli placed on a line slightly anterior to middle of compound eyes, farther removed from one another than from compound eyes. Antennae many segmented; basal segments but slightly longer than wide, middle and apical segments progressively becoming longer than wide. Mandibles flabby and nonfunctional.

Pronotum essentially quadrangular, much broader than long, angles somewhat rounded, pronotal flange well developed on anterior and posterior margins but weakly so on sides; embossings indistinct.

Legs with first tarsal segment but slightly longer than second, third tarsal segment more than twice as long as first and second together.

Wings long, extending well beyond tip of abdomen; membrane and veins pale, a few veins more brownish; hind wing rarely with intercubital cross-veins, venation essentially typical of this genus, as now recognized in North America.

Abdomen with dorsal segments without special structures. Tenth tergite, fig. 83, not cleft; subanal lobes essentially weakly sclerotized lobes, without well-developed upturned or recurved hooks. Ninth sternite strongly produced and turned upward over tenth sternite so that it is not visible from below, without a padlike disk near middle of apical portion. Eighth sternite with a small but rather broad lobe in middle of posterior margin.

Length to tip of wings 11 mm.; length to tip of abdomen 8 mm. No gill remnants on any body area.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general

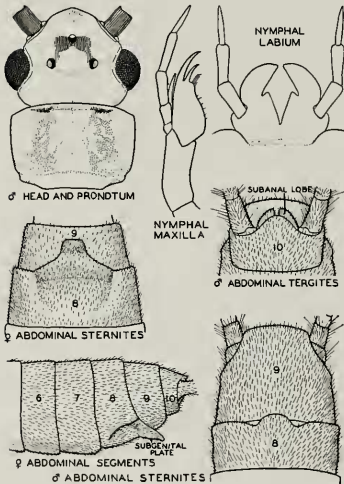


Fig. 83.—*Isoperla truncata*.

similar to those of male. Differs from male as follows: eighth abdominal sternite, fig. 83, with a well-developed process or subgenital plate which projects well over the ninth sternite, truncate at tip and in side view turns down from body at an angle.

Holotype, female.—Spooner, Wis., Namakagon river: June 5-6, 1936, Frison & Ross, reared from nymph.

Allotype, male.—Same data as for holotype.

Paratypes. INDIANA.—Knox, Yellow river: May 24, 1937, H. H. Ross, 21♂, 4♀.

MICHIGAN.—Omer, Rifle river: May 21, 1936, Frison & Ross, 1♂. Big Rapids, Muskegon river: May 22, 1936, Frison & Ross, 1♂, 8♀. Grayling, Manistee river: June 17, 1935, T. H. Frison, 4♂, 4♀. Lovells, Au Sable river: May 22, 1935, 1♂; north branch, May 24, 1936, J. W. Leonard, 1♂. Crawford county, north branch Au Sable river: June 16, 1935, J. W. Leonard, 2♂, 3♀. Cheboygan county, Pigeon River State Forest, Pigeon river: July 21, 1935, J. W. Leonard, 6♂, night at light. Otsego county, Pigeon river: June 23, 1936, J. W. Leonard, 1♀.

WISCONSIN.—Same data as for holotype, 3♀; same data except not reared, 18♂, 8♀.

The adults of this species are best distinguished from other species of this genus by the characteristic dark patch on head near ocelli and in the female by the truncate subgenital plate which sticks out from the body at an angle, fig. 83. In all respects this is a typical species of *Isoperla* (r. s.), as now recognized in North America, belonging to the group of species now having *I. bilineata* (Say) as type.

The nymph of this species has been collected as well as the adult and therefore its description is given. Association of the nymph with this new species is based upon reared specimens. The nymph is quite characteristic of other *Isoperla* (r. s.) as this genus is now recognized in North America. It is perhaps most easily separated from other species known to me by the two longitudinal rows of prominent spots on dorsum of thorax.

NYMPH.—General color of head, thorax and abdomen a whitish yellow with dark markings as in fig. 84. The most important dorsal dark markings are the broad transverse band across head, the two longitudinal rows of spots on thorax, and the three narrow longitudinal stripes on abdomen. Cerci pale yellowish brown.

Head with three ocelli forming a nearly equilateral triangle, lateral and median ocelli occupying the same relative position as in adult. No occipital ridge. Labium and maxillae as in fig. 83.

Pronotum about twice as wide as long, all angles well rounded; fringed with short as well as some long hairs; marginal groove well defined on anterior and posterior margins but absent on lateral margins. Mesonotum with wing pads extending almost straight backwards, those on metanotum extending slightly outward.

Legs very little flattened; hind margins of femora, tibiae and tarsi with a fringe of long fine setae. Tarsal segments 1 and 2 very short; third segment long, about three times as long as first and second combined.

Cerci many segmented, moderately long, stout at base, segments progressively longer apically, distal half with a row of long fine setae on dorsal surface in addition to shorter ones encircling segments.

Approximately mature specimens with a body length, exclusive of appendages, of about 10 mm. Submental, thoracic and abdominal gills entirely lacking.

Nymphs. MICHIGAN.—Omer, Rifle river: May 21, 1936, Frison & Ross. Grayling, Manistee river: May 22, 1936, Frison & Ross. Mio,

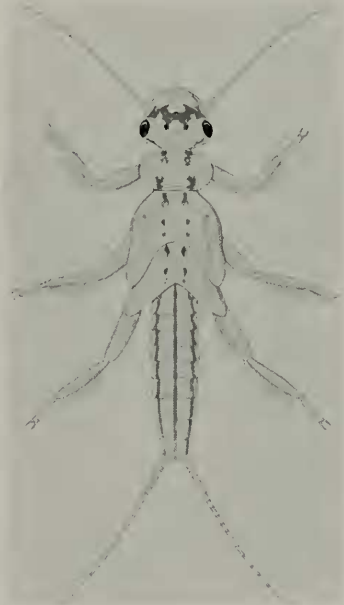


Fig. 84.—Nymph of *Isoperla truncata*.

Au Sable river: May 21, 1936, Frison & Ross. Lovells, Au Sable river: May 22, 1936, Frison & Ross. Hale, Au Gres river, May 21, 1936, Frison & Ross.

WISCONSIN.—Dells, Wisconsin river: June 5, 1936, Frison & Ross. Spooner, Namakagon river: June 5-6, 1936, Frison & Ross.

Cast nymphal skins. MICHIGAN.—Honor, Platte river: Sept. 16, 1936, Ross & Burks.

WISCONSIN.—Spooner, Namakagon river: June 5-6, 1936, Frison & Ross.

Alloperla exquisita Frison

Alloperla exquisita Frison (1935b, p. 337).

This species was originally described from males only and from material collected in Oregon. Additional material from Washington and British Columbia has

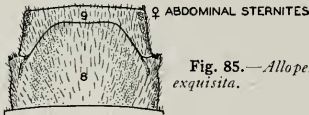


Fig. 85.—*Alloperla exquisita*.

made available the previously unknown female and therefore the description of this sex is now given.

FEMALE.—Similar in most morphological features to the male (Frison 1935b). Eighth abdominal sternite, fig. 85, with subgenital plate produced backwards over about one-half of ninth sternite and with posterior margin approximately truncate.

Allotype, female.—Shucksan, Wash., Bagley creek, 2700 feet elevation; July 24, 1936, H. H. Ross.

BRITISH COLUMBIA.—Cultus lake, Smith Falls creek: May 20, 1935, W. E. Ricker, 1♂, 1♀.

WASHINGTON.—Shucksan, Bagley creek, 2700 feet elevation: July 24, 1936, H. H. Ross, 5♂, 11♀; Razorhone creek, 3200 feet elevation: July 24, 1936, H. H. Ross, 14♂, 11♀.

Alloperla occidentis—NEW SPECIES

MALE.—Body, cerci, antennae and legs in general a pale yellowish white. Dark or black areas are as follows: ocelli and compound eyes, fig. 86, lateral margins of pronotum, a U-shaped mark on meso- and metanotum, a broad median longitudinal stripe extending across all abdominal tergites up to the ninth, and basal segments 1 through 3 with a small dark stripe on each lateral margin running parallel to median stripe.

Head wider through compound eyes than width of pronotum; median ocellus located about in line with anterior margins of compound eyes, lateral ocelli located well anterior to line connecting posterior

margins of compound eyes, distance between lateral ocelli greater than distance between a lateral ocellus and adjacent compound eye.

Pronotum much wider than long, front angles rather sharp, hind angles more rounded.

Dorsum of abdomen as in fig. 86. Supra-anal process small, inset on tenth tergite, forming a fingerlike projection which in lateral view is slightly swollen at tip; eighth and ninth tergites without raised ridges. Tenth tergite cleft for reception of supra-anal process, without distinct inward-pointing lobes or hooks at bases of cerci.

Wings extending well beyond tip of abdomen; with membrane and veins pale; a well-formed anal lobe on hind wing and in this respect, as well as venation in general, agreeing with *Alloperla* as now recognized in North America.

Length to apex of wings 8 mm.; length to tip of abdomen 6 mm. No gill remnants on any body area.

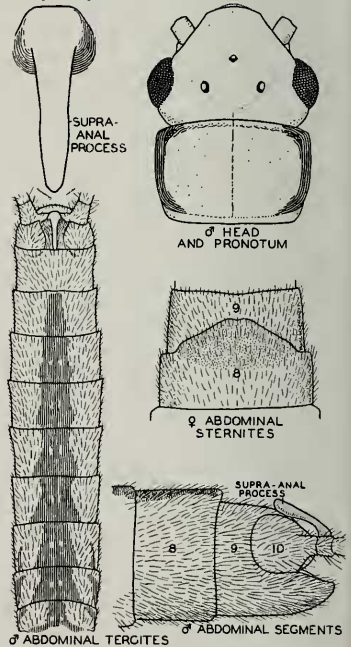


Fig. 86.—*Alloperla occidentis*.

FEMALE.—Similar in most morphological characters to the male. Median longitudinal dark stripe on abdominal tergites extending only to eighth tergite, and lateral stripes only on first and second tergites. Eighth abdominal sternite, fig. 86, with subgenital plate extending in middle area over about one-half of ninth sternite, posterior margin somewhat broadly triangular and depressed.

Holotype, male.—Shucksan, Wash., Razorhone creek: July 24, 1936, H. H. Ross.

Allotype, female.—Same data as for holotype.

Paratypes.—Same data as for holotype, 1 ♂, 4 ♀.

This species resembles *A. exquisita* Frison (1935b) in general color pattern. It differs in the male, however, in lacking a transverse ridge on ninth tergite and in the female the subgenital plate is more triangular.

SYNONYMY

Acroneuria lycorialis (Newman)

Acroneuria cuetstae Ricker (1935b), p. 260. New synonymy (♂, ♀).

A male and a female paratype of *Acroneuria cuetstae* Ricker, kindly sent to me for the SURVEY collection by W. E. Ricker, prove upon close study and comparisons with other material to be the species *A. lycorialis* as defined by Needham & Claassen (1925). The name *cuetstae*, therefore, must be relegated to synonymy.

Togoperla media (Walker)

Acroneuria salvelini Ricker (1935b), p. 261. New synonymy (♀).

A study of a paratypic female sent to me for the SURVEY collection by W. E. Ricker and a second paratypic female loaned by the Canadian National Museum prove that these are the same as the common northern and eastern American species now going by the name of *media* (Walker). The name *salvelini*, therefore, must be synonymized.

Togoperla immarginata (Say)

Acroneuria fumosa Ricker (1935b), p. 262. New synonymy (♀).

Examination of a paratypic female of *A. fumosa* Ricker, loaned by the Canadian National Museum, and comparisons with other material, including a female specimen and a nymphal skin named as *fumosa* by Ricker and sent to me by him, have enabled me to recognize this as *immarginata* (Say)

as defined by Needham & Claassen. The name *fumosa* must therefore be placed in synonymy.

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